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The Journal of Bone and Joint Surgery

OUR NOVITIATES

AN ADDRESS BY DR. A. MACKENZIE FORBES, THE FORTY-SECOND PRESIDENT OF THE AMERICAN ORTHOPAEDIC ASSOCIATION
Washington—May, 1928

As Chairman of this, the Forty-Second Annual Meeting of the American Orthopaedic Association, I would welcome not only our members, but our ever welcome guests!

I think that we cannot too often repeat that those who practise our branch of general surgery are banded together to relieve deformities—to make straight children—and we are all children. I accentuate this because there are too many who still insist that our very designation is from the Latin and not from the Greek.

During my term of office it has been a pleasure to see the great love which so many of our members bear for the American Orthopaedic Association.

In order that membership may always be a privilege, I feel that we should ever agree that our numbers should be limited. Our Association should not be a school for those who aspire to be orthopaedic surgeons, but rather, it should be a union of the masters of orthopaedic surgery whose aim and object should be the propagation of knowledge.

It is for this reason that we welcome our guests,—indeed they are more than welcome, because we shall exchange views, and their very presence will encourage us in our high ideal, the spreading of that knowledge which will give hope to those who live in the darkness of deformity.

Yes, gentlemen, let us remember that we are priests and teachers. Each and every one of us has dedicated his life to the high aspiration of making others happier.

Decades have rolled by, and our fathers in so called orthopaedic surgery have labored and have done their part. In dying, they handed on the torch to us. This torch is our heritage. Others may help, but they cannot fulfil the privilege entrusted to us. The possession of gold can do much. The enthusiasm of novelty can do much. These cannot relieve the suffering of the child or the anguish of the parents. Yet if these be our

high ideals—if we, not others, are the guardians of the holy places—we must fit ourselves for our high estate. Our specialty, more than any other specialty, is a cult. It is an order of priesthood, the priesthood of service, and as such our novitiates must be chosen with the greatest of care from amongst those who were destined to serve. Their education must be our common privilege and duty.

Orthopaedic surgeons are born—not made. Besides judgment—that quality which measures success in any vocation—the qualities necessary to make an orthopaedic surgeon are, in many ways, similar to those of the scientist and investigator.

First, patience—our results are rarely immediate. "Precept upon precept; line upon line; here a little, there a little," must be our motto.

Second, originality. Every orthopaedic surgeon differs from his confrères, but each has one thing in common with the others, and that one thing is originality.

Third, generalship. As an example of the necessity for generalship, it may be suggested that every patient suffering from a paralysis presents a problem of a different character. Are not generalship and originality demanded in order to plan a campaign which will offer some measure of hope for the afflicted?

It has often been said that orthopaedic surgeons should be the product of evolution and not of special training. This is true in the sense that no degree of training will give originality and some of the other attributes of the orthopaedic surgeon. Yet the catholicity of knowledge is important.

An orthopaedic surgeon should be first a general surgeon. Just as the road to general surgery is the study of what is often called internal medicine, so the orthopaedic surgeon should be a highly trained general surgeon whose powers of observation, whose armamentarium should be the product, first of Destiny, and second of the medical and neurological wards.

Orthopaedic Surgery is a science and not an art. It is true that much of the routine work of orthopaedic surgery calls only for manual dexterity, but, perhaps to a larger extent the same applies to general surgery.

Is not Orthopaedic Surgery often the court of last appeal? If such be true, what experience, what knowledge, and what clinical sense are required!

Much of the original work of recent years is the product of those interested in orthopaedic surgery. Have we read Sir Arthur Keith's "Menders of the Maimed" and taken pride in our heritage?

We must encourage breadth,—the breadth of science. The very fact that much of the routine work of any branch of surgery is essentially technical, makes it imperative that we so train our novitiates that science will dominate, and art but serve. We must avoid all alliances, and especially with those whose practices are so narrow that there should be no place for them in the family of Medicine.

The study of disease has but begun! Let us unite with those who are students first and practitioners afterwards!

ON THE PERIPHERAL NERVE COMPLICATIONS OF CERTAIN FRACTURES*

BY HARRY PLATT, M.D., M.S., F.R.C.S., MANCHESTER, ENGLAND

From the Orthopaedic Service, Ancoats Hospital

INTRODUCTION

In the compound injuries of modern warfare, and to a lesser extent in those of civil life, the coincidence of a fracture and a nerve lesion excites little surprise. For such nerve lesions are usually conditioned by factors beyond the immediate control of the surgeon. But in the ordinary simple fractures, peripheral nerve complications are admittedly rare, and when they occur, often appear in somewhat unexpected fashion. This is particularly true when the signs of nerve involvement are first recognized, during the early weeks following the injury. It is then that the methods used in the treatment of the fracture become open to criticism.

The circumstances under which the different nerve trunks are implicated vary considerably, and in order to illustrate the rôle of the several factors which may be concerned in the genesis of these nerve lesions, I have chosen somewhat arbitrarily three clinical groups—(1) Nerve injuries accompanying fractures of the elbow; (2) Musculospiral involvement in fractures of the shaft of the humerus; and (3) Involvement of the external popliteal nerve in fractures of the upper end of the fibula.

PERIPHERAL NERVE COMPLICATIONS OF ELBOW FRACTURES

The elbow region provides the greater proportion of the nerve lesions associated with simple fractures. Of the large series of dual injuries collected by Dean Lewis and Miller in 1922[1], in sixty per cent. the fractures involved the lower third of the humerus. Every type of elbow fracture may on occasion show a peripheral nerve complication, but the great majority of the lesions accompany fractures of the lower end of the *humerus*. The incidence of such complications in fractures treated under the conditions of an organized hospital service, with unity of control, appears to be exceedingly low. In support of this statement the following statistics may be quoted from the surgical service of the writer. The figures do not include compound fractures admitted direct to the wards, or complicated fractures referred for treatment only at a later stage.

*A paper read at the Annual Meeting of the American Orthopaedic Association, Washington, May 1, 1928.

ANCOATS HOSPITAL

Recent Elbow Fractures—(1921–1926 Inclusive)

Bone Injury	Total	Nerve Complication	Spontaneous Recovery	Operation
Humerus—lower end	419	12 Ulnar 1 Median Incidence 3%	10 1	2 ..
Olecranon	62	None	..	..
Radius—upper end	71	None	..	..
	552	13	11	2

Nine of the ulnar lesions accompanied fractures of the *internal epicondyle;* and three, *supracondylar* fractures.

A consideration of the above figures suggests that these dual injuries are comparatively rare, and that under ordinary circumstances, the nerve lesions are by no means serious. But from time to time one is called upon to deal with complicated fractures in which the responsibility for the early treatment fortunately lies elsewhere. Such experiences tend to emphasize in one's mind the gravity of many of the accompanying nerve lesions, and a clear conception is gained of the influence of injudicious treatment on both the genesis of the nerve lesion, and the prospects of recovery.

The various elbow fractures and their typical nerve complications may now be considered in turn.

SUPRACONDYLAR FRACTURES

Any one of the three important nerve trunks of the upper limb may be involved in a supracondylar fracture.

ULNAR LESIONS. *Pathogenesis.* The ulnar lesions are always of the incomplete type and are due either to a primary contusion, or to a *secondary* friction neuritis arising about three to five weeks after the injury. True primary lesions are probably rare and are of minor importance, unless the nerve block is perpetuated by factors which determine the onset of a secondary neuritis. The chief cause of secondary ulnar neuritis is a disturbance of the normal relation between the nerve and its bed in the postcondylar groove. In the treatment of all fractures of the lower end of the humerus, there would appear to be a critical stage at which the ulnar nerve may be damaged by the repeated stretching, which accompanies the

natural unforced movements of the elbow joint. This is a rare sequela in the supracondylar fracture which has been promptly and efficiently reduced, where the elbow has been rested in flexion for some two weeks, and where mobilization of the joint has been carried out by the patient's unassisted efforts alone. But where the nerve has already sustained a contusion, or where the nerve bed has been even slightly disturbed as a result of the fracture, a mild friction or traction neuritis is readily induced by ordinary movements of the elbow. If there is a considerable distortion of the nerve bed, as in uncorrected *lateral* displacement of the lower fragment (Fig. 1); or if in contravention of all the principles of correct treatment, *forced* movements are used; a severe neuritis is almost certain to result. Such are the factors which separately or in combination ordinarily explain the involvement of the ulnar nerve in supracondylar fractures.

FIG. 1

Supracondylar fracture with lateral displacement of the lower fragment. Ulnar nerve involvement.

Treatment. A primary lesion is in its inception an inevitable complication, but its continued existence as a secondary neuritis is preventable by timely treatment. As already stated, secondary neuritis arising *de novo* may also, very rarely, be an unavoidable complication. Under such conditions, when the first signs of nerve block are recognized, the nerve should at once be protected from the cumulative trauma of stretching. The elbow should be rested, and all mobilization efforts suspended. The intrinsic muscle palsy should be treated by the ordinary physiotherapeutic measures,—interrupted galvanic stimulation, light massage, and so forth. Movements of the elbow should be resumed only when the signs of block or irritation are fast disappearing.

In the average primary contusion, or mild secondary neuritis, such a régime will promote complete recovery of function in the nerve, and the mobility of the elbow can be restored later without difficulty. But in the more severe types of neuritis, associated either with uncorrected displacement, or a stiff painful elbow which has been subjected to repeated forcible manipulation, the value of early operative treatment must be emphasized. It is fortunate that for ulnar neuritis an ideal form of neurolysis is available in the familiar operation of *anterior transposition*, in which the nerve is removed from all harmful influence. Once the nerve has been displaced forwards and securely buried, gentle and graduated movements of the elbow joint may be practised with impunity. It is now the custom of the author to operate without delay in all cases of *severe* ulnar neuritis complicating recent fractures of the lower end of the humerus. During the past year he has operated on five cases of this type.

MEDIAN LESIONS. *Pathogenesis.* The median nerve is rarely involved in supracondylar fractures unless complete backward displacement of the lower fragment has occurred, and the pointed or jagged end of the

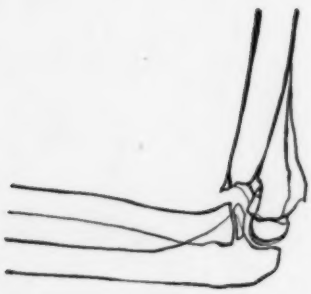

FIG. 2

Supracondylar fracture with forward displacement of the shaft. Median nerve involvement.

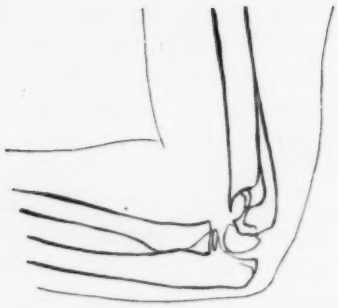

FIG. 3

Supracondylar fracture with forward displacement of the shaft. Median nerve involvement, and ischaemic contracture.

shaft has perforated the brachialis anticus (Fig. 2). The nerve is either contused or torn at the moment of displacement (primary lesion), or later becomes adherent to the projecting "spike" (secondary lesion). Where the efforts to reduce the fracture have been clumsy, or where forced movements have been used at a later stage, the nerve trunk invariably sustains additional damage. The median lesions produced in this fashion tend to be grave, and complete division is sometimes encountered. The clinical picture is occasionally further complicated by the presence of ischaemic contracture of the forearm muscles. In such cases the nerve may be implicated either at the level of the projecting shaft, or as it passes between the fibrosed flexor muscles (Fig. 3).

Treatment. Where the fracture has been efficiently reduced, and the signs of median involvement are slight, it is reasonable to try conservative treatment for a short period. But where the bony displacement remains uncorrected, and particularly where an ischaemic contracture is also present, the injured nerve should be explored. The procedure to be

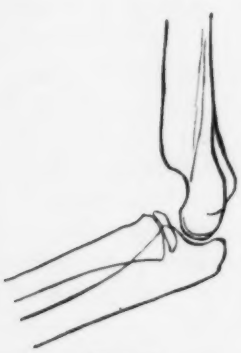

FIG. 4

Elbow shown in Fig. 2 after removal of projecting spike.

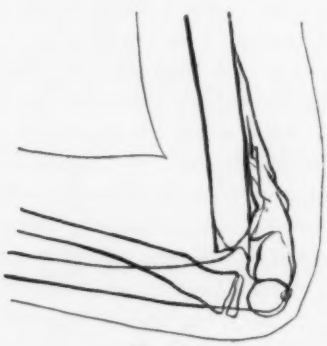

FIG. 5

Supracondylar fracture with forward displacement of the shaft. Complete musculospiral nerve lesion.

adopted will depend on the gravity of the lesion. After releasing the nerve, or performing an end-to-end suture, the trunk should be placed in a new bed, lined by a muscle flap which covers the raw area left by the removal of the projecting bony spike (Fig. 4). Perfect recovery should follow neurolysis, and the prospects after suture are also favorable if the operation be not unduly delayed. In three cases operated on during the past two years, complete recovery of function was seen after neurolysis.

FIG. 6

Separation of the internal epicondyle. Ulnar nerve involvement.

MUSCULOSPIRAL LESIONS. Involvement of the musculospiral nerve is rare in supracondylar fractures, and occurs only where *lateral* displacement of the lower fragment leaves a sharp bony spike or ridge (Fig. 5). On this the nerve is immediately impaled, or later becomes adherent. Here, also, injudicious manipulative treatment may contribute to the local destruction of nerve tissue as in lesions of the ulnar and median.

During the past seven years the author has seen *four* cases only of musculospiral involvement in supracondylar fractures. In three, spontaneous recovery occurred; in the fourth a complete lesion was dealt with by end-to-end suture, which was followed by perfect restoration of function.

INTERNAL EPICONDYLAR FRACTURES

Separation of the internal epicondyle is rarely seen before the age of twelve, and usually results from a direct impact to the elbow. The small fragment tends to be drawn downwards by the pull of its muscular attachments, and the postcondylar groove may thus undergo a slight permanent alteration (Fig. 6). For obvious reasons the *ulnar* is the only nerve implicated in this type of fracture, and such injuries account for the majority of the ulnar lesions accompanying recent elbow fractures (See Table). In the typical case the nerve is contused at the moment the fracture occurs. The signs of nerve block are usually slight and transitory, but a secondary neuritis may develop under circumstances which have already been described. Spontaneous recovery is the rule, but in the occasional case of severe neuritis, the operation of anterior transposition should be practised without delay.

EXTERNAL CONDYLAR FRACTURES

In *recent* fractures of the external condyle, nerve involvement is unknown, but many years after the injury the syndrome of *late ulnar palsy*

FIG. 7

Posterior dislocation of the elbow joint with separation and displacement of the internal epicondyle. Antero-posterior view. Ulnar nerve involvement.

may appear. This interesting lesion has in recent years acquired a considerable literature; its clinical picture is now familiar to most surgeons, and its treatment by the operation of anterior transposition is generally accepted[2].

The prevention of late ulnar palsy lies in the more efficient treatment of external condylar fractures, which form some thirty per cent. of the injuries of the lower end of the humerus in childhood. The tendency to rotary displacement of the large fragment, the difficulty of obtaining accurate reduction, and the failure to achieve bony union are well known. A determined effort should be made to restore the fragment to its old position, either by manipulation or open operation, in order to minimize the cubitus valgus deformity which is most conspicuous in later years. In the experience of the author reposition often fails, and excision of the condyle is sometimes required. But although this operation gives an immediate satisfactory cosmetic and functional result, it does not necessarily prevent future increase in the carrying angle.

FRACTURE OF THE FOREARM BONES

In fractures of the *olecranon* or upper end of the *radius*, nerve involvement is quite exceptional. The author has operated on two interesting and unusual cases. In one,—an olecranon fracture,—after five or six months, the signs of a friction neuritis of the ulnar developed, which was quickly relieved when the nerve had been transposed to the front of the elbow. In the other, a late *posterior interosseous palsy* was seen twenty-one years after a fracture of the head of the radius. On exposure of the nerve trunk between the two layers of the supinator brevis, a small fusiform neuroma was demonstrated. The nerve was left *in situ*, and the distorted head of the radius was removed. For some incomprehensible reason the operation was followed by recovery in the extensors of the middle three digits formerly paralyzed.

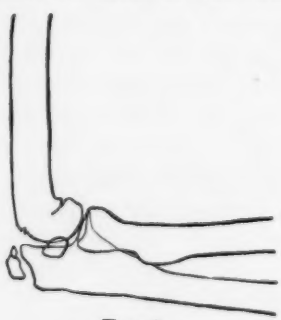

FIG. 8

Lateral view of same elbow.

DISLOCATIONS OF THE ELBOW JOINT

The *ulnar nerve* is occasionally implicated in recent dislocations of the elbow accompanied by separation of the internal epicondyle (Figs. 7 and 8). In its pathogenesis and treatment the nerve injury differs in no respect from the lesion associated with the ordinary fractures of this bony prominence.

SUMMARY

1. Every type of recent elbow fracture may be accompanied by a peripheral nerve lesion, but such complications are almost unknown except in fractures of the lower end of the *humerus*.

(a) The *ulnar* lesions occur most often in internal epicondylar fractures, and occasionally in supracondylar fractures, or dislocations of the elbow joint. The lesions are always incomplete, and may be due to a primary contusion, or a secondary friction neuritis developing in the first few weeks. A mild transitory neuritis is sometimes seen in fractures treated efficiently, but the severe lesions are almost always due to ineffective or injudicious treatment—*e.g.*, imperfect reduction, clumsy manipulation, or forced movements of the elbow. In severe neuritis, early operation is always advisable.

(b) The *median* and *musculospiral* lesions are less common. They are usually associated with supracondylar fractures, where there is considerable displacement of the lower fragment. The nerve trunks are contused, torn, or frayed out by a sharp bony projection. The median lesions are often grave, and generally demand operation.

2. The prevention of peripheral nerve involvement in fractures of the lower end of the humerus lies in the due observance of the three canons of treatment:—

(a) Early and accurate reduction of the fracture (The importance of *lateral* displacement of the lower fragment in supracondylar fractures should not be overlooked).

(b) A period of complete rest for the elbow, lasting from ten to fourteen days.

(c) Cautious and gradual mobilization of the elbow by the patient's own unassisted efforts.

Forced movements at any stage are always disastrous.

MUSCULOSPIRAL NERVE INVOLVEMENT IN FRACTURES OF THE SHAFT OF THE HUMERUS

Pathogenesis. It has been estimated that the musculospiral nerve is implicated in four to eight per cent. of humerus fractures (Scudder[3]). In a series of sixty consecutive fractures of the shaft of the humerus, treated from the beginning in the author's clinic, a musculospiral palsy was seen in three cases only (incidence five per cent). One showed a rapid spontaneous recovery. Of the two remaining, in one a complete lesion was repaired by suture, and in the other, an incomplete lesion was treated by neurolysis. In both, complete recovery was seen.

As in dual injuries elsewhere, the musculospiral lesions may be primary or secondary. But it is not always easy to define the chronology of the

nerve lesion, for although wrist-drop is usually a dramatic clinical sign, the palsy is not infrequently overlooked during the first week or ten days.

Primary lesions are probably due to the impact from within of one of the fractured surfaces, for a study of radiograms shows that the line of fracture is usually oblique, and involves the musculospiral groove (Figs. 9 and 10). This fact emphasizes the need for care and gentleness in the handling of humerus fractures at the time of reduction. Secondary lesions are popularly ascribed to the enclosure of the nerve trunk in callus, a description which from the experience of the author bears little relation to actual fact. For a long time

FIG. 9

Oblique fracture of the middle third of the humerus with musculospiral nerve involvement (Complete anatomical division).

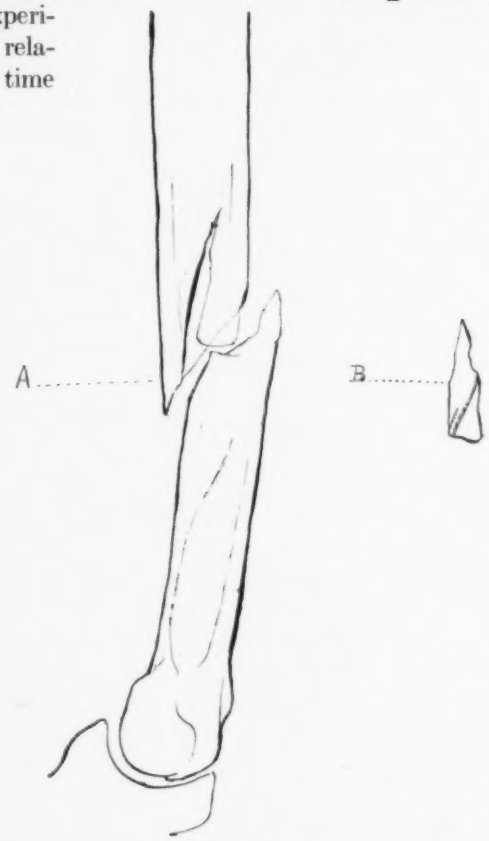

FIG. 10

(a) Fracture of shaft of humerus, middle third. Musculospiral nerve involvement.
(b) Small comminuted fragment, adherent, and slightly puncturing the nerve sheath.

he has regarded compression by callus as one of the rarest causes of nerve injury associated with fracture. Secondary involvement usually means that the nerve has become adherent to a sharp bony margin, or anchored in the region of the groove. This is the earliest phase of a localized destruction of the nerve trunk by a slow process of attrition. In long standing lesions a large nerve spindle is found on the proximal trunk, and connected to the distal trunk by an attenuated segment or a fibrous cord (Fig. 11).

Such a sequence of events is little influenced by the type of treatment employed after the setting of the fracture, in striking contradistinction to the nerve lesions at the ebow.

Prognosis and Treatment. When the syndrome of a complete musculospiral block is recognized, an attempt should be made to assess the extent of the lesion as soon as possible. On the whole an undoubted primary lesion is likely to be grave, and may be anatomically complete from the date of injury; whilst in a secondary lesion the trunk will contain a number of intact nerve bundles for some little time at least. The radiographic appearances may be of diagnostic value. Sharp "spiking" in the area of the musculospiral groove will suggest the possibility of a severe laceration or complete division (Fig. 10). Clinical evidence is helpful only when a change in the syndrome is noted after a period of observation. It must be remembered that where degeneration in the distal part of the nerve trunk has occurred, the first signs of returning power in the proximal muscles (supinator longus, etc.) are not appreciable before the twelfth to the sixteenth week.

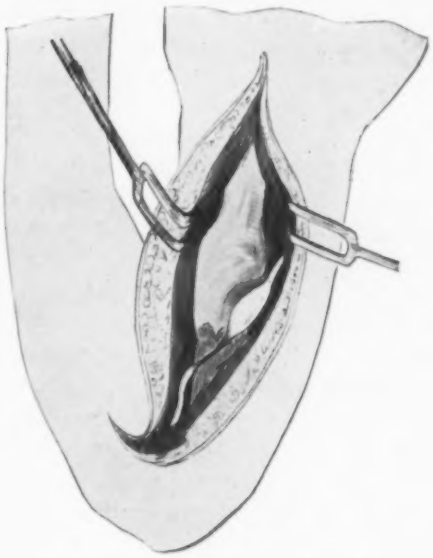

FIG. 11

Old fractured humerus. Musculospiral nerve involvement. Shows neuroma on proximal end of nerve trunk, connected with distal trunk by a slender fibrous cord.

From past experience it appears to be sound practice to treat *secondary* musculospiral lesions by conservative methods for a period of three or four months, as the proportion in which spontaneous recovery occurs is considerable. If the signs of nerve block remain stationary after such a probationary period, exploration is then required. In this nerve, in contrast with the median and ulnar, delay does not materially affect the prognosis after end-to-end suture. But in the *primary* injuries, where a grave lesion is suspected, early operation is generally advisable. After repair of the lesion, the nerve trunk should be protected from contact with the area of fracture. In recent lesions a sufficient muscular flap is usually available, but in long standing injuries the nerve bed should be lined by a sheet of fascia lata. We are therefore justified in regarding musculospiral nerve involvement in simple fractures of the humerus as ordinarily an unavoidable complication, rarely if ever conditioned by neglect or injudicious treatment of the bony injury.

EXTERNAL POPLITEAL (PERONEAL) NERVE INVOLVEMENT IN FRACTURES OF THE UPPER END OF THE FIBULA

In the various types of fracture of the upper end of the fibula—which are all comparatively rare injuries—occasional involvement of the external popliteal nerve has long been a recognized complication. Of special interest are the fractures in which the styloid process alone, or a more considerable fragment, has been detached by strong traction (Figs. 12 and 13). This injury may be part of a dislocation of the knee joint. Most of the references to fractures of the upper end of the fibula are found in the older literature. In a recent paper by Perrin and Labry[1] a distinction is made between styloid fractures and fractures of the fibular neck. In the former, involvement of the external popliteal nerve is said to be exceptional, and then merely a transitory phenomenon; whilst in the latter fracture, a severe nerve lesion is regarded as a more frequent and typical complication. The author's experience does not support these conclusions. For during the past seven years he has seen no example of external popliteal involvement in fractures of the fibular neck, but on the other hand has operated on *four* traction lesions of this nerve combined with fracture of

FIG. 12

Traction fracture of upper end of fibula, with external popliteal nerve involvement.

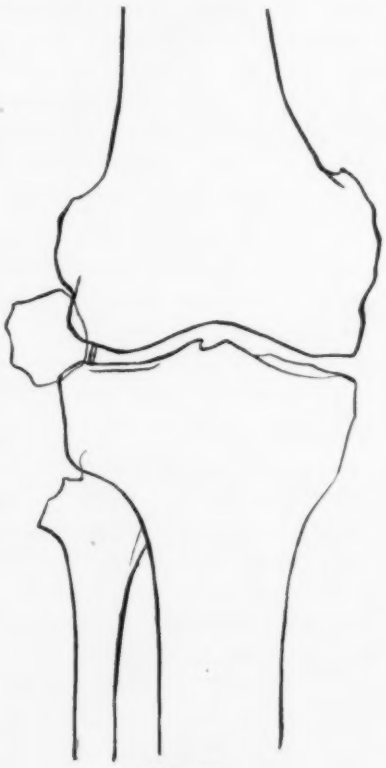

FIG. 13

Fracture of upper end of fibula with external popliteal nerve involvement.

the styloid process. In three of these a complete rupture of the nerve had occurred, necessitating the operation of end-to-end suture. In the remaining case the nerve trunk, when explored six weeks after the injury, was found to be intact, but swollen and infiltrated with hemorrhage. The three nerve sutures were performed ten days, three months, and three years, respectively, after the injury. In the first, perfect recovery of function resulted at the end of eighteen months; in the second there was feeble power in the anterior tibial group at the end of three years; and in the third, after three years there was not the slightest sign of regeneration.

This is admittedly an uncommon nerve lesion, and one cannot dogmatize from such a limited number of cases. But the author's experience would lead him to stress the value of early exploration of the nerve in this particular type of dual lesion. At the time of the operation, the displaced bony fragment to which part of the biceps tendon and external lateral ligament are inserted, should be reattached. If this is not practicable, as in a late operation, the bony fragment may be removed.

Thus the external popliteal nerve lesion which accompanies separation of the fibular styloid, is a true primary injury which bears no *causal relation* to the treatment of the fracture.

The author is indebted to his colleague, Dr. Margaret H. Greg, for the illustrations accompanying this article.

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DISCUSSION

Dr. Dean Lewis, Baltimore, Md.: Mr. Platt has covered so thoroughly the nerve injuries associated with fractures that there is little to discuss. Emphasis, which is timely, has been laid upon the danger of injury to the ulnar nerve already damaged by passive motion of the elbow. The dangers of such treatment aggravating a lesion which is already present cannot be too often emphasized. Most of the ulnar nerve lesions associated with fractures have been late lesions. The external condyle has been fractured in childhood. Union has not occurred, and a cubitus valgus has developed. Late ulnar nerve palsies are not so uncommon. In view of the fact that they are associated with non-union of the external condyle, the question arises at once whether it would not be better to operate upon this type of fracture to replace the condyle and fix it in position.

The musculospiral nerve is the one most frequently injured. The most common type of lesion is primary contusion followed by stretching over a displaced fragment. It has been my experience, as it has Mr. Platt's, that a nerve is rarely caught in callus. The nerve is frequently found adherent to the bone by dense scar tissue.

A median nerve injury associated with a supracondylar fracture of the humerus is

not uncommon. The nerve is usually stretched over the lower end of the upper fragment. Median nerve injuries also occur with anterior dislocation of the carpal bones.

There are certain types of fractures in which nerve injuries occur and in which the nerve should be explored at once and the fracture reduced at the same time.

In those cases in which no primary operation has been attempted, I believe that the nerve should be explored at the end of three months if there is no distinct evidence of recovery, and by recovery I mean return of muscle power and function. This is an arbitrary time limit, but if recovery has not occurred then, it probably will not occur.

It is exceedingly difficult to make a differential diagnosis between anatomic interruption of a nerve and interference with its conductivity, the continuity being preserved.

Exploration in these cases is, I believe, perfectly justified after three months. When the nerve is exposed the operation indicated may be performed, and the operation most frequently indicated will be neurolysis.

DR. FRANK D. DICKSON, Kansas City, Mo.: I am very glad indeed that this paper so very clearly set forth, and that Dr. Lewis did likewise in his discussion, the necessity for early operation on nerve injuries associated with fracture. I do not believe there is a more harmful attitude to assume toward any injury than waiting for a nerve injury to get well, once it is definitely established, because ascending degeneration sets in and your result is bound to be much less satisfactory than if you got it early. I reported a series of twenty-seven injuries three years ago, and we proved to our own satisfaction, at least, that if you get nerve injuries under six months you can, with few exceptions, get one hundred per cent. good results. If you see them after a year, the percentage of good results falls and after two years it is almost nil. One of the valuable points of this paper is the importance of early exploration.

MR. HARRY PLATT, Manchester, England (Closing the discussion): I do not think there is any more to add, except to join with Dr. Lewis and Dr. Dickson in emphasizing the value of exploring most of these nerve injuries complicating fractures at a very early stage.

STABILIZING THE LOWER SPINE*

BY EDWARD A. RICH, M.D., TACOMA, WASHINGTON

Without entering into any discussion regarding types of pathology presented in the lower spine and sacro-iliac region, let us presuppose that there are conditions in that region that need stabilizing by bone graft or other means.

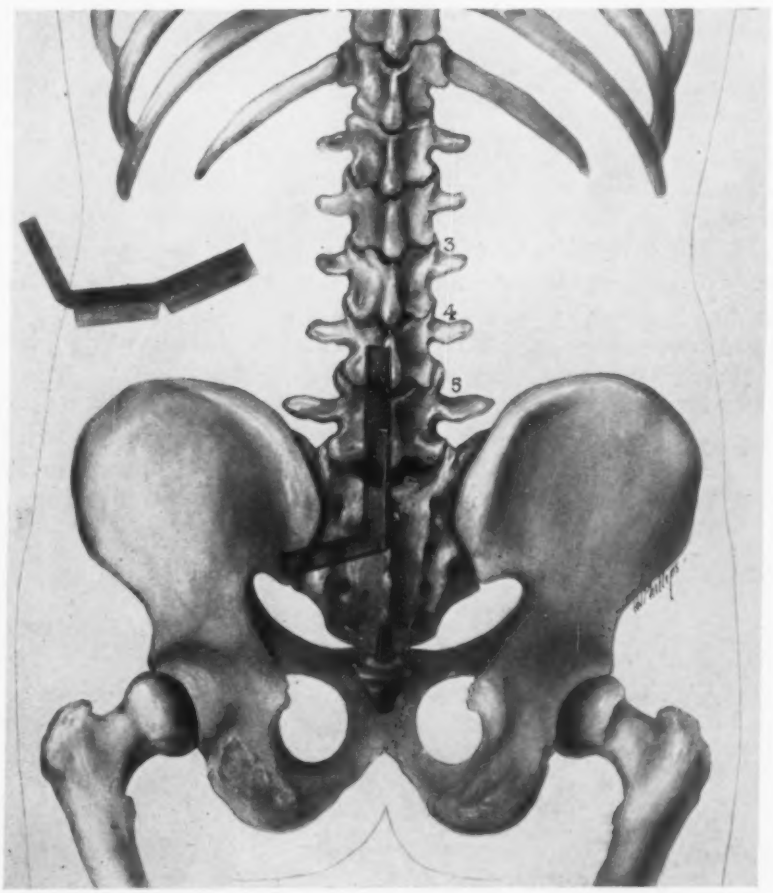

FIG. 1

"Shotgun" graft to immobilize the lower spine and one sacro-iliac.

*Read before the North Pacific Surgical Association, Victoria, British Columbia, Dec. 3, 1927.

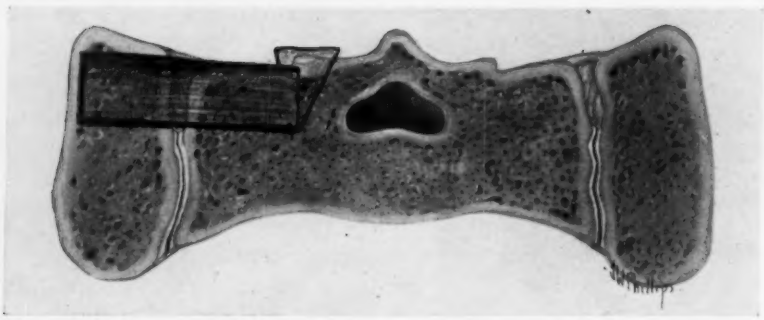

FIG. 2

Section through middle level of sacro-iliac articulation. Notice congenial site for cuneiform graft.

Two procedures are here presented which I have tested out and found worthy.

First, there are anomolies and displacements of the fifth lumbar vertebra, or overangulation of the weight-bearing surface of the sacrum, or deformities of the upper sacrum, that we believe are *primary causes* of symptoms; but in addition, there is either a relaxation of the sacro-iliac, or referred pain to one sacro-iliac joint that is responsible for *secondary* symptoms.

Most sacro-iliac symptoms are referred or secondary; yet we are certain that there is some sacro-iliac pathology.

A "shotgun" bone graft of about seven inches in length (Fig. 1) is implanted in the spinous processes of the lower two or three lumbar vertebrae, and, further into the external lateral crest of the sacrum to nearly the middle of the sacrum, and thence extended laterally in a grave across

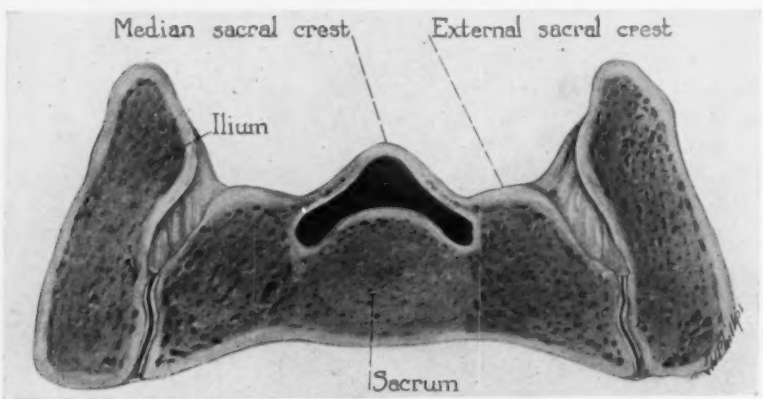

FIG. 3

Cross section through top of sacro-iliac articulation. Note irregularities, making graft impossible.

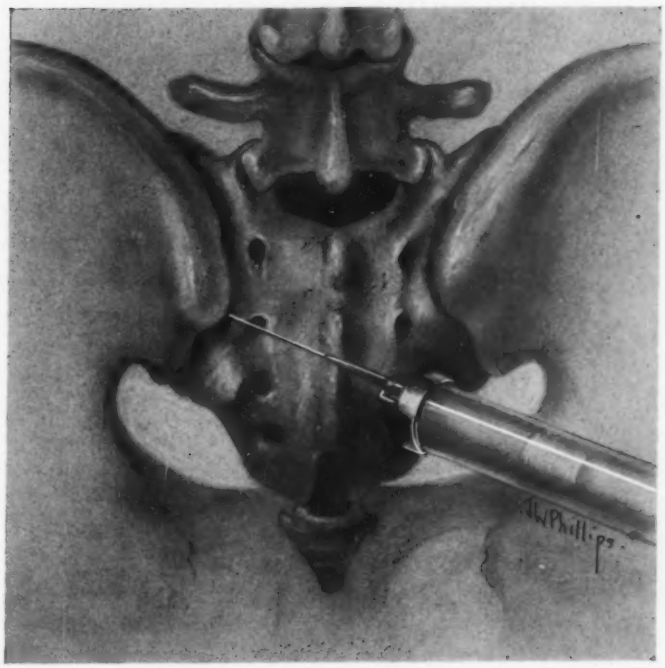

FIG. 4
Chemical injection—arthrodesis of sacro-iliac.

the lower portion of the sacro-iliac joint just above the posterior superior spine (Fig. 2). The graft is green-sticked in one place to conform to the spinal concavity and is cut through to the periosteum in one place to permit the outward angulation. Fortunately for our mechanics a grave higher up is impossible on account of the high, raised, flaring crest (Fig. 3). I have done this often in recent months, with solid ankylosis following and without sequelae.

Again, in sacro-iliac mobilities where stability has been required, I have injected directly into the joint cartilages, between the sacrum and ilium, some five to fifteen drops of supersaturated tincture of iodine. The injection is easily made with a two and one-half inch, twenty-two gauge needle. The barrel of the syringe rests on the opposite buttock over the crest of the ilium (Fig. 4).

For many years, by this chemical irritation, I have secured moderate inflammations which have resulted in firm ankylosis.

FRACTURE OF THE SPINE WITHOUT PARALYSIS

BY F. N. G. STARR, C.B.E., M.B., F.A.C.S., TORONTO

On October 12, 1927, the writer was consulted by a young married man, thirty-five years of age, who complained of "stomach trouble" following an injury about twenty years previously, from which it was said a hernia of the diaphragm had resulted. While the injury necessitated his confinement to bed for nearly two years, because of a large hematoma on the back, there is no history at any time of any paralysis. He had perfect control of the bladder and intestinal functions, and very little pain, notwithstanding the fact that his second lumbar had been crushed and crowded backward so that the anterior surface of the bodies of the first and third had come in contact.

A few months previous to his consulting me, he noticed a small lump below and to the left of the ensiform cartilage. This had increased in size until it was now apparently about the size of a grapefruit. On palpation it was hard, resistant, slightly movable with respiration, and with a marked pulsation, and slightly tender.

His appetite was good but he had more or less constant discomfort over this mass.

A lateral plate of his spine was made (Fig. 1), and it showed the anterior surface of the body of the first lumbar in contact with the anterior surface of the third lumbar, the second being wedge-shaped, and crowded backward. A barium meal was given, and, while the stomach at first sight appeared to be in the pleural cavity, on close investigation of the plates, it was found that the diaphragm was above the stomach throughout, although it will be seen from Figure 2 that the fundus of the stomach is well toward the level of the base of the heart.

After further investigation the author became convinced that as there was resonance over the front of the chest down to the edge of the costal border on the right side, and as the duodenal cap showed in the x-ray to be well over to the left, the pulsating lump that one could feel was the under aspect of a rotated liver, it having been displaced to the left.

A corset with an abdominal lift was applied across the abdomen and attached to a brace which fitted on each side of the kyphosis, and this has given him perfect comfort. His pain was evidently due to the drag.

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TORONTO 2, ONT., CANADA.

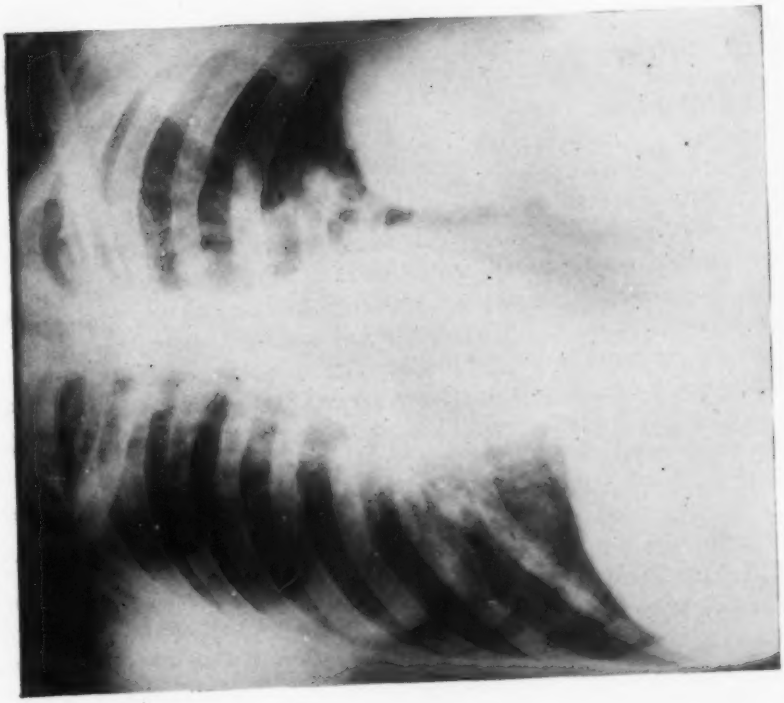

FIG. 2

FIG. 1

THE DIFFERENTIAL DIAGNOSIS OF SARCOMA OF THE LONG BONES*

BY WILLIAM B. COLEY, M.D., NEW YORK

Periosteal sarcoma as distinguished from central sarcoma. The old term *periosteal sarcoma* is not a strictly scientific one, inasmuch as most cases of so called periosteal sarcoma do not start in the periosteum proper, but beneath the periosteum, and are, strictly speaking, subperiosteal, the classification given to them by Gross[1]. Furthermore, as these tumors advance, they extend in both directions and soon involve the periosteum externally and the cancellous structure internally, so that in cases in which early amputation is performed, a section of the bone will show the entire bone to be involved with the tumor process, and the medullary cavity to be completely obliterated. For clinical purposes, however, it may still be well to use the term *periosteal sarcoma* when referring to all types of malignant tumor of the long bones that are not manifestly of central origin.

Classification of bone sarcoma. There has never been any uniform classification of bone sarcoma. In the older text-books, these tumors were divided into two groups, — *i.e.*, periosteal sarcoma and central sarcoma. Recently there has been an attempt to differentiate a considerable number of varieties. Nové-Josserand and Tavernier[2], in their recent and very valuable monograph upon the subject of Malignant Tumors of Bones, have adopted a very simple, and yet a very useful classification. It is as follows:

1. Osteosarcoma
2. Giant-cell tumors (myeloplaxes)
3. Myeloma
4. Endothelioma
5. Secondary bone tumors

The classification adopted by the Bone Sarcoma Registry Committee of the American College of Surgeons is as follows:

1. Metastatic tumors primary in tissues other than bone
2. Periosteal fibrosarcoma
3. Osteogenic tumor { a. benign / b. malignant
4. Inflammatory conditions
5. Benign giant-cell tumor
6. Angioma { a. benign / b. malignant

*Read at the annual meeting of the American Orthopaedic Association, Washington, May 1928.

7. Ewing's tumor
   a. diffuse
   b. angio-endothelioma
   c. endothelial myeloma
8. Myeloma

Diagnosis of periosteal sarcoma of the long bones. Of first importance is a very careful clinical history; and in getting this, one should give heed to the following salient points:

1. Age of patient
2. Date of appearance of pain or tumor
3. Antecedent local trauma
4. Location of tumor (shaft or extremity)
5. Duration of symptoms before tumor was observed
6. Condition of neighboring joint
7. Amount of disability of limb

In making a physical examination, the following points should be carefully noted:

1. Color of skin
2. Dilatation of superficial veins
3. Presence or absence of local temperature
4. Consistence of tumor
5. Involvement of neighboring joint
6. Size of tumor
7. Presence or absence of pulsation

Roentgenograms of the bone should be carefully examined, and in addition, a recent film of the chest should be obtained. In doubtful cases a microscopic section, obtained by exploratory operation, should be submitted to the pathologist.

Relative frequency. Sarcoma of the bone is a comparatively rare condition. Its relative frequency as compared with malignant disease of other parts of the body has never been definitely determined, and none of the health statistics, as far as I know, supply the requisite data to enable one to determine this point. Kolodny[3], in his admirable study of bone sarcoma, based on an analysis of the cases recorded in the Registry of Bone Sarcoma of the American College of Surgeons, states, with reference to the incidence of primary malignant bone tumors, that about one case out of three of sarcoma of the human body is a "bone sarcoma", the next in frequency being lymphosarcoma. From a careful survey in the State of Massachusetts, it is estimated that the clinical incidence of "bone sarcoma" is about one to 100,000 of population at any one moment. Kolodny states that, "According to these calculations there are about 1,100 to 1,450 patients with 'bone sarcoma' alive at any one time in the United States". The statistics of Putti and Camurati[4] are the only ones that I know of in which all the cases of bone sarcoma for a period of thirty years have been carefully recorded. During this period at the Rizzoli Institute of Bologna, there were observed 190 cases of bone tumors, of which 116 were of the malignant, and 74 of the benign type. The number of tubercu-

lous conditions of the bone observed was 5,000, showing the proportion of the former group to the latter to be three and eight-tenths per cent. (one and seven-tenths per cent. osteogenic sarcoma).

From 1890 to 1928, or during a period of thirty-eight years, I have personally observed 856 cases of bone sarcoma (496 of the long bones) at the Hospital for Ruptured and Crippled, the Memorial Hospital, and in private practice. This includes sarcoma of the flat bones as well as inoperable sarcoma of the long bones.

Age of patient. Sarcoma, especially bone sarcoma, has a predilection to youth; and the majority of cases occur between the ages of fifteen and thirty years. A review of two groups of operable long bone cases, personally observed (170 periosteal and 50 giant-cell), shows the following age-incidence:

Periosteal Group	*Patients*
Up to and including 5 years	2
6 to 10 years	16
11 to 20 years	67
21 to 30 years	41
31 to 40 years	27
41 to 50 years	11
51 to 60 years	3
Over 60 years	3
	170

Giant-cell Group	*Patients*
5 to 10 years	4
10 to 15 years	5
15 to 20 years	8
21 to 30 years	17
31 to 40 years	6
41 to 50 years	5
51 to 60 years	4
Over 60 years	1
	50

Symptomatology. The first symptom is usually pain; and in the majority of cases the pain is noted some days or weeks or possibly months before a tumor is observed. The interval elapsing between the appearance of the pain and that of the tumor depends much upon the locality of the lesion. If the tumor starts in the pelvic bone, pain may be felt for a number of months before a palpable tumor is discovered; but in such cases a roentgen-ray examination will usually reveal the presence of a tumor in an early stage. This is not always the case. I have observed certain cases in which severe pain in the region of the hip was the only symptom, and in which repeated roentgen-ray examinations failed to disclose any pathologic lesion of the bone. In one case, the pain continued to increase in severity so that the child was unable to sleep at night; a second series of x-ray pictures taken two weeks later was likewise negative; two weeks later a tumor in the

region of the trochanter was noticed, which proved to be an osteogenic sarcoma of such a high degree of malignancy that it caused death in four months.

The character of the pain is worthy of note. The pain is at first intermittent and varying in intensity. It is usually more severe at night, regardless of whether or not the limb is at rest. It usually increases in intensity as the tumor progresses. There are certain cases, however, in which the pain is not severe.

Altogether, pain occurring with a tumor of the long bones in a healthy young person without evidence of inflammatory trouble, accompanied by temperature and local heat, should make one suspicious of sarcoma.

Antecedent trauma. While most of the older writers have given little weight to the theory that antecedent local trauma may be a causative factor in the development of malignant tumors, and while some still question the importance of this factor, although admitting its frequent occurrence, I believe that a study of a series of complete case reports cannot fail to convince the most skeptical that trauma plays a very definite and important rôle in the development of sarcoma of the long bones. In a group of 170 cases of periosteal sarcoma of the long bones, a history of definite antecedent local injury was given in eighty-seven or slightly over fifty per cent. of the cases. In a group of fifty cases of giant-cell sarcoma of the long bones, a history of antecedent local trauma was given in twenty-eight or fifty-six per cent. of the cases.

Locality of tumor. Sarcoma is more apt to occur in certain bones and in certain portions of bones, — *e.g.*, in our series of 170 cases of primary malignant tumor of the long bones, the locality of the tumor was shown as follows:

	Femur	*Tibia*	*Fibula*	*Humerus*	*Radius*	*Ulna*	*Clavicle*
Upper end	10	22	6	29	1	—	
Mid-shaft	19	7	—	5	2	1	
Lower end	44	4	2	2	3	—	
	73	33	8	36	6	1	7

The majority of the cases in which the tumor occurs in the shaft are of the type now classed by Dr. Ewing as *endothelioma*. This type is distinguished by little new bone formation and by marked bone destruction, often resulting in early pathologic fracture.

The cases in which the tumor occurs near the extremity of the bone are of the osteogenic type associated with new bone production.

Duration of symptoms. The clinical course of bone sarcoma varies in such wide degree that it often makes an early diagnosis a matter of great difficulty. We may have a case, as has occurred in my experience, in which the disease progresses so rapidly that it causes death within four months from the date of the original trauma that was, apparently, the cause of the development of the tumor (In my case roentgen-ray examination at the time of the trauma showed nothing abnormal). On the other hand, we may

have a case in which the progress of the disease is so slow that death is postponed for five or more years. In these cases of long duration, there is always the possibility that in the early stages of the disease the tumor was a benign process and only in the later stages assumed malignant features. As a rule, periosteal sarcoma is of rapid growth and in non-amputated cases causes death from metastases of the lungs or other regions within a period of one to two years; in cases in which amputation is performed, death usually occurs within a period of one year after amputation.

In making a diagnosis of a bone tumor in the early stages, it is very important to note its size and duration. If it is of small size and has been noticed for one or two years, and is not associated with severe pain, the chances are that it is not malignant. If it is of large size and of short duration, and painful, the evidence points more strongly, although not conclusively, to its being a malignant process. If the tumor is of considerable size and of very short duration, and especially, follows an injury of considerable severity, such as a football injury to the region of the quadriceps muscle of the thigh, it is possible that the condition is one of myositis ossificans or ossifying hematoma. If the history shows that the tumor reached considerable size in one or two or three weeks and then became quiescent, the diagnosis of myositis ossificans is still further strengthened. A stereoscopic roentgen-ray examination will usually make it possible to differentiate the two conditions.

A true sarcoma may occur almost immediately after a local trauma, although many authorities deny this. There can be no doubt that certain cases justify the classification of *acute traumatic malignancy* that has been given them. In these cases, the tumor appears almost immediately after the injury. I have observed a number of such cases in which the roentgen-ray and clinical evidence proved beyond any doubt that the tissues at the site of the tumor were quite normal before the injury.

The fact that these cases of acute traumatic malignancy do occur in just about the same time as that in which a myositis ossificans may develop, makes it often extremely difficult to differentiate the two conditions. I shall dwell upon this more fully later on.

Physical examination. The following points should be noted most carefully:

1. *Appearance of skin.* One should note whether it is normal in color, or pale or purplish, due to dilatation of the superficial veins. If the swelling is due to a tuberculous osteitis with abscess formation, the skin is apt to be paler than normal. If it is due to a sarcoma, the veins are usually dilated, so much so in tumors of considerable size, as to cast a deep purplish hue over the skin. The diagnosis should be made before these changes have taken place.

2. *Consistence of tumor.* Much information may be gained from a careful palpation of the tumor. The consistence of a periosteal sarcoma is firm but not of bone-like hardness. It differs from an osteitis or myositis ossificans, in that the latter is much harder; and from a tuberculosis of bone

with abscess formation, in that the latter is softer and often associated with a sense of fluctuation. After the tumor has attained a large size it may become soft and semifluctuating, but in such instances its entire appearance and rapid growth should leave little doubt of the diagnosis.

3. *Location of tumor.* If the joint is involved at an early stage, it is practically certain that the process is not a sarcoma but probably tuberculosis. The function of the joint is rarely impaired at an early stage, but may become so later on. The joint may be invaded during the progress of the disease in periosteal sarcoma, giant-cell sarcoma, and central malignant sarcoma.

4. *Size of tumor.* The size of the tumor may vary from a slight elevation of the periosteum to a huge tumor. I have seen a sarcoma of the upper end of the humerus in a boy of five years, increase steadily during three and one-half months until it had reached a size greater than that of the patient's head, and had involved the entire humerus including the elbow joint, proving fatal within five months. In most cases, however, the disease is of much slower progress.

5. *Temperature.* In most cases there is slight local heat which can be detected by palpation. In very rapidly growing tumors this feature is quite marked. As a rule, a sarcoma of the bone is not accompanied by any rise in general temperature; but there are numerous exceptions, for example, a patient with a very rapidly growing periosteal tumor, who has developed general metastases. The rise of temperature in these cases is probably due to the breaking down of the rapidly growing tumor cells and the absorption of the toxins or products of degeneration. A most striking example in this connection is the case of rapidly growing sarcoma of the humerus in a boy of five years, cited above. In this case, even when the tumor was half its greatest size, the temperature often ranged from 102 to 103 degrees for days; then after a brief period of remission, and as the tumor increased in size, the temperature rose to 103 and 104.5 degrees. This tumor was soft and semifluctuating but not ulcerated.

Roentgen-ray examination. This should always be made when possible, since it is of the greatest help in making a diagnosis of bone sarcoma. In many cases the picture is so characteristic that it is possible to make a positive diagnosis from this alone. In other cases, while it may furnish valuable evidence, it is not conclusive, and must be weighed carefully with all the other evidence, — *i.e.*, the clinical history, physical examination, and, possibly, a microscopical examination of a biopsy specimen. In the following conditions, the roentgenograms alone may permit a positive diagnosis: (a) osteogenic sarcoma associated with a large amount of new bone, spicula of which radiate at right angles to the shaft; this cannot be mistaken for any other condition; and the clinical history and rapid growth of the tumor will further confirm the diagnosis. In these cases a biopsy is unnecessary and should not be performed. (b) In most cases of myositis ossificans the roentgenogram is usually so characteristic that a positive diagnosis can be made. (c) In cases of endothelioma (endothelial

myeloma) of the bone, the roentgenogram may enable one to make a positive diagnosis in a certain number of cases, especially those in which the disease is more advanced or those in which a pathologic fracture has occurred.

In many cases, however, it is impossible from the roentgenogram alone to differentiate endothelioma of the bone from subacute or chronic osteomyelitis, and from metastatic carcinoma, especially hypernephroma.

Roentgen-ray examination may show the following bone changes: There may be abnormal or increased opacity due to destruction or increased density of bone. In the giant-cell type it is not uncommon to find trabeculae, which may disappear as the outlines of the bone become lost in the tumor mass. The two processes of bone destruction and bone production may be mixed together in the same case, one part of the tumor showing rarefaction and the other, bone production. In periosteal sarcoma, roentgen-ray examination may show the periosteum slightly eroded, raised and irregular, differing markedly from the clean-cut periosteal line which is found in myositis ossificans. Furthermore, a rather definite characteristic of this type is that the new bone formation radiates at right angles to the diaphysis. It should be noted that this occurs in only eighteen per cent. of the cases. In the endothelioma type of sarcoma of the shaft of a long bone, the roentgenogram may show a laminated structure with little or no new bone formation.

While the roentgenogram is one of the most important aids in making a diagnosis of a bone tumor, it must be clearly understood that its correct interpretation is by no means an easy matter, and requires a large experience in the study of bone tumors. As Kolodny has well pointed out, "the tendency in vogue a decade ago to overestimate the importance of a roentgenogram in the diagnosis of a skeletal tumor has been followed lately by a swing toward underestimating its importance". In making a roentgen-ray diagnosis of a given case, it is very important to know the stages of the disease and the nature of the treatment already employed. I quite agree with Kolodny that, with our growing knowledge of this subject it will be necessary in the future to make more extensive use of the roentgenological features of bone tumors for diagnostic purposes. He states that, "from a study of the extensive material of the Registry (Bone Sarcoma) one arrives at the conclusion that roentgenology is not sufficiently appreciated by the average physician in dealing with bone tumors and too few roentgenograms are being taken". The rapid development of a periosteal sarcoma makes it essential to take frequent roentgenograms. This has been emphasized by a number of cases that have come under my own observation in which the early pictures showed no pathologic lesions and yet pictures taken a week or two later showed definite evidence of sarcoma.

It must be remembered that there are two types of osteogenic sarcoma: one, in which production of new bone is the most prominent feature, and the other, in which destruction of bone with little production of new bone is the outstanding feature.

Kolodny has divided the cases of osteogenic sarcoma of the Registry into two groups, according to the age of the patient—*i.e.*, the first including all patients under twenty years of age, and the second, all patients over twenty years of age. In the first group—covering an age when the growth of the skeleton is at its height—it was found that bone production was predominant in eighty-six per cent. of all cases, while in the second group—an age when the skeletal growth has been completed—production of bone prevailed in only sixty-two per cent. The arrangement of radiating spicules was very much less frequently observed in the older group than in the younger.

The roentgenological features of a bone tumor of the benign type differ from those of the malignant type. In the former the density is much more uniform, the outline of the tumor is much more sharply defined, and the destruction of cartilage is much more marked. In the benign type, the cartilage is usually found about the outer edge of the tumor, while in the malignant type it may be diffused throughout the tumor.

Biopsy. My views regarding the value of biopsy in the diagnosis of tumors of bone are, probably, too well known to justify a full repetition here; but inasmuch as there is still great confusion and the widest difference of opinion among surgeons and pathologists as to the advantages or disadvantages of biopsy, I will state my own position as briefly as possible. During recent years, the dangers of biopsy have been repeatedly pointed out; and in my opinion, they have been somewhat unduly emphasized. The result has been that when the average surgeon observes an early case of suspected bone tumor, he is at a loss to know just what to do. In discussing the *pros* and *cons* of biopsy in bone tumor, one should admit freely at the beginning, that a biopsy is associated with certain definite disadvantages, the most important of which are (1) the danger of disseminating living tumor cells throughout the circulation and thus giving rise to metastases, and (2) the risk of infection at the site of the biopsy, or, the formation of a slowly healing and persistent sinus. The first danger, while theoretically possible, has been encountered so seldom in our experience with a large number of cases of all types observed at the Ruptured and Crippled and Memorial Hospitals, that it need cause little concern. This opinion is still further confirmed by the experimental studies of Dr. Francis Carter Wood relating to biopsy in the treatment of malignant tumors in animals.

The second danger, that of infection, is really the more important one. There have been recorded a number of cases of tumor of the long bones in which biopsy has been followed by serious infection; and in not a few, amputation has had to be performed in order to save the life of the patient. I have had three such cases, although in only one was the biopsy or curettage performed by myself. Furthermore, these cases were nearly all observed before the introduction of Dakin's solution. Under modern surgical technique, and with the aid of Dakin's solution, I believe that serious infection following biopsy for a long-bone tumor should rarely

occur. In osteogenic sarcoma, the biopsy wound usually heals promptly. In central or giant-cell sarcoma, the biopsy should never be undertaken merely for diagnostic purposes but it should be regarded as an essential part of the treatment. It should not be limited merely to the removal of a small portion of the tumor, but it should consist of a complete and thorough curettage down to healthy bone. This greatly reduces the danger of infection as well as the danger of hemorrhage, which not infrequently proves alarming when a limited biopsy has been performed on a highly vascular giant-cell tumor of the long bones, especially of the femur.

Now, what are the advantages of a biopsy that outweigh the disadvantages already mentioned? First, we may gain an accurate idea of the histological structure of the tumor, which may aid us in determining whether it is an inflammatory or a neoplastic process. If we are certain that it is the latter, then it is important to know its particular type, *e.g.*, whether it is a benign or malignant central tumor, or whether it is an osteogenic sarcoma or endothelial myeloma. While it is true that the clinical and roentgen-ray evidence may permit a positive diagnosis in the majority of cases, it is also true that there are a considerable number of cases in which we cannot make a positive diagnosis from such evidence alone, and yet the hope of saving the limb or even the life of the patient depends largely upon a correct diagnosis in the early stage of the disease. It is to just this group of cases that I would limit a biopsy; and furthermore, I believe that the biopsy should not be undertaken as a routine procedure by any surgeon who happens to see the patient first, but should be performed if possible by a surgeon who has had a large experience with bone tumors, and who is prepared to carry out whatever method of treatment is indicated. I would exclude altogether from a biopsy, all tumors of the pelvic bones, especially of the ilium. These tumors are practically all inoperable when first discovered, and the further knowledge obtained from the biopsy will not materially influence the treatment. They are nearly all malignant. The benign ones will usually give a clinical history of slow development, and a roentgenogram will usually make the diagnosis easy. The objection to a biopsy in these cases is that there is a strong tendency on the part of the wound to remain open, to become fungating, and eventually, to develop an infection, thus adding enormously to the pain and discomfort of the patient, and materially shortening his life. I have seen a number of cases, even in recent years, in which just these results have followed biopsy; and I now strongly advise against this procedure in all cases of tumor of the pelvic bones.

Differential diagnosis. We must distinguish between a malignant tumor of bone, a parosteal tumor not connected with bone, a non-malignant tumor of bone, and other conditions simulating the various types of bone sarcoma, clinically or roentgenologically.

1. *Parosteal or extra-periosteal tumor.* It is nearly always possible to differentiate a parosteal tumor from a malignant bone tumor by the clinical signs: (1) the location: it is situated on one side of the long bone and does not

surround it as is nearly always the case in periosteal sarcoma; (2) palpation will show that it can be moved independently of the bone; (3) the consistence is usually softer than that of a periosteal sarcoma. Furthermore, the roentgenogram will show the periosteal line intact and not irregular or indented as in periosteal sarcoma.

Although Nové-Josserand and Tavernier state that periosteal tumors are easily differentiated from tumors of the bone, I have observed several cases in which the diagnosis was extremely difficult.

Aneurysm. It should not often be difficult to distinguish a sarcoma of the bone from an aneurysm, but such mistaken diagnosis has been made and by surgeons of large experience. An aneurysm may simulate a pulsating malignant tumor of bone so closely that it may be impossible to make a definite diagnosis without surgical intervention. Even the roentgenogram, which one would expect to settle the question, may give little help. An aneurysm in close proximity to the bony skeleton may cause erosion and destruction of the bone and so closely simulate a condition caused by a neoplasm of the bone, that even with the aid of a roentgenogram, an early diagnosis may be difficult. Here, again, the clinical history is an important factor. From it we learn that the swelling has developed rapidly; that it has been associated with considerable pain; and that the patient is showing evidence of cachexia. All these clinical signs would strongly favor the diagnosis of neoplasm. The location also is of great help. There are only two locations in which difficulty is likely to arise,—*viz.*, the thoracic cavity and the popliteal regions. In the latter, there is seldom much bone destruction; and the clinical history and physical signs will nearly always make it possible to render a correct diagnosis. In the thoracic cavity, an aneurysm of the aorta is of much slower development than is a neoplasm; while the roentgenogram may show destruction of the vertebra, this is not usual and is found only in long continued and advanced cases. But, most important, a blood or spinal Wassermann test will show the presence of lues.

Osteomyelitis. This condition is one which, in my opinion it may be more difficult to diagnose than is almost any other. In some of the cases that have come under my own observation, it has been found impossible to make a diagnosis from the clinical and roentgenological evidence even when supplemented by the macroscopic evidence obtained by biopsy. In a very few cases, the additional evidence furnished by a microscopic examination of the tissues removed at biopsy may leave the diagnosis still unsettled. The latter, however, are rare; and in these cases, the future development of the disease or the end result will finally settle the diagnosis.

In acute osteomyelitis the symptoms,—*i.e.*, rapid onset and high temperature, are fairly characteristic and usually prevent one from mistaking the condition for that of neoplasm of the bone. I remember only one case of the latter in which the condition very closely resembled in every way an acute osteomyelitis; there was sudden onset of the disease after an

injury, high temperature and rapid formation of a tumor. This case is so important that I have described it in brief in my discussion of myositis ossificans.[6]

The type of osteomyelitis that most closely simulates periosteal sarcoma or endothelioma (Ewing's tumor) of bone, is the subacute type which is rarely associated with fever and often follows a local trauma. Here the picture, even when interpreted by an expert roentgenologist, is of little help in differentiating the condition from one of sarcoma.

CASE 1. SARCOMA OF THE FEMUR, ENDOTHELIOMA TYPE. ORIGINAL DIAGNOSIS OF OSTEOMYELITIS WAS BASED UPON CLINICAL, ROENTGENOLOGICAL, MACROSCOPIC AND MICROSCOPIC EVIDENCE.

P. T., male, aged fourteen years, was admitted to the Hospital for Ruptured and Crippled, service of Dr. Whitman, on December 7, 1922, with the following history: Three months previously the patient began to limp and complained of pain in the region of the left hip. He became very restless at night, lost ten pounds in weight. There was no fever. Physical examination at the time of his admission to the hospital showed the left leg held flexed at an angle of 160 degrees, could be abducted at 15 degrees, and very slightly rotated outward. Flexion and extension were almost entirely restricted; internal and external rotation were somewhat restricted, and there was very marked tenderness to pressure over the great trochanter. A roentgen-ray examination was made at this time, and the report was as follows: "There is a general periosteal thickening of the upper extremity of the femur which apparently extends to a point four inches below the trochanter minor, involving the periosteum and extending up to the neck, but apparently not involving the neck of bone. The interior of shaft shows changes indicative of disease."

A Wassermann test was made and proved negative.

On December 11, 1922, the patient was operated upon by Dr. Royal Whitman. A long incision was made down over the trochanter, through the muscles to the bone. Periosteal tissue and pus were at once encountered. The tissues were separated from the bone, and the external layer of the cortex was removed for a distance of about three inches; but one-third of the bone seemed to be involved, and nothing was found in the interior; bone became solid. According to Dr. Whitman, the condition was evidently a periostitis and not an osteomyelitis except as a secondary condition. He stated that the tissues through which he cut were more or less laminated, simulating the different layers of an onion.

Pathological report by Dr. F. M. Jeffries: "Extensive and intensive acute osteitis; etiology does not appear".

The wound was kept open and dressed with Dakin's solution and the patient was discharged on January 11, 1923. On February 7, 1923, he returned to the Hospital for Ruptured and Crippled for examination. During the intervening month, a very great change had taken place in the thigh. This had increased in circumference to twenty-four inches. The veins were markedly dilated and distended. The swelling was firm in consistence, but not of bony hardness. Several of the inguinal glands were enlarged. At this time the clinical evidence of a rapidly growing inoperable sarcoma was beyond question. The patient was referred to me for treatment and was transferred to my service at the Memorial Hospital. Roentgen-ray examination at this time, February 1923, showed that a very great change had taken place since the last examination was made. There was now a good deal of destruction of bone without much new bone formation. Clinical and roentgenological diagnosis was that of sarcoma of the endothelioma type. The original microscopic sections were examined by Dr. Ewing, who pronounced them to be sarcoma of the epithelioma type.

During his stay at the Memorial Hospital, the patient received treatment with the radium pack (50,000 mc. hours), which was applied at a distance of ten centimeters over

three different areas of the femur in a period of four days; and in addition he received systemic injections of the mixed toxins of erysipelas and bacillus prodigiosus. During the following three weeks the tumor decreased very markedly in size, the circumference of the femur at the end of this time was fourteen inches. Roentgen-ray examination also showed marked changes to have taken place. The patient's general health improved. In April, 1923, he showed evidence of metastases in the skull, jaw, and other regions of the body, and in spite of further treatment, he died in June, 1923.

The foregoing case illustrates well the difficulty encountered even by men of unusual experience in bone pathology, in making a diagnosis in rapidly developing sarcoma of the femur. Here we have a boy of fourteen years, with a large swelling of the upper half of the femur which developed within a few weeks and which, in the opinion of Dr. Royal Whitman, had the clinical and roentgen-ray features of an osteomyelitis or a periostitis of the femur. Dr. Whitman made a six-inch incision, cutting through the soft parts, and chiselling out the interior of the bone. He found some material which he regarded as pus. In his opinion, the macroscopic appearance of the tumor found on exploration was that of a chronic osteitis. Furthermore a microscopic examination of the tissues removed was made by Dr. F. M. Jeffries, the pathologist of the hospital, and his diagnosis was that of chronic osteitis; no evidence of a neoplasm was noted. The wound healed; and at the end of one month, the patient returned home. A month later, he was readmitted. At this time he had a huge tumor involving the whole upper two-thirds of the shaft of the femur, measuring twenty-four inches in circumference, with dilated veins; and having all the clinical appearances of a sarcoma. The patient was referred to my service; and it was thought best to treat him with a combination of local radium and systemic toxins. He was given 50,000 millicurie hours of radium in the form of a pack applied at ten centimeters in one week, and the toxins were given in increasing doses up to the point of producing marked reactions, temperature of 104 degrees. Within eight weeks, the circumference of the tumor had decreased from twenty-four inches to fourteen inches; but within three months, very extensive general metastases developed in the bones and soft parts, and the patient died in six months from the time the disease was first noted. A careful review of the microscopic sections—in the light of subsequent developments—resulted in the diagnosis being revised to that of sarcoma of the femur of the endothelial type. In reviewing the roentgenograms taken in the early stages of the disease one might well regard them as being equally characteristic of a neoplasm as of an osteitis. I did not have the opportunity of seeing this patient until his readmission to the hospital at which time no one could have failed to make a diagnosis; but Dr. Whitman recalled one important feature found at the exploration and that was, in cutting through the tumor mass, he noticed that the tissues were arranged in layers similar to those of an onion. This laminated structure, I believe, is not infrequently found in the endothelial type of sarcoma; at any rate, I have noted this, what I believe to be important diagnostic feature, in several of my own cases.

In another case already published[6], a young woman, aged twenty years, the clinical and roentgenological evidence seemed sufficiently strong to permit a positive diagnosis of periosteal sarcoma with an unusually large amount of new bone. This patient came to me in 1909, and while I felt reasonably certain from the history, clinical appearance and roentgenograms, that her condition was one of periosteal sarcoma, I did not feel justified in amputating the thigh without first having a microscopic examination made. Under ether, I chiselled deeply into the bone and removed several good-size pieces of tissue. To my surprise, the latter looked exactly like healthy cancellous bone. The specimens were submitted to Dr. Ewing whose microscopic diagnosis was that of myositis ossificans. In view of the macroscopic appearances and the microscopic sections showing no evidence of sarcoma, I declined to amputate, and sent the patient home. In two and one-half years she returned still in good health, but with marked increase in the size of the tumor which looked even more like a sarcoma. Again I performed an exploratory operation, chiselling out several ounces of bony tissue from the most prominent part of the tumor, which was examined microscopically and which again failed to show any evidence of sarcoma. A few weeks later a soft, rapidly growing tumor appeared at the center of my incision; this was explored and proved to be a giant-cell sarcoma. I then amputated the leg at the thigh, but the patient developed metastases in the lungs and pelvis, and died seven months later.

When I reported this case, I was inclined to believe that the original condition was one of chronic osteitis which later had changed its character and had become a highly malignant periosteal sarcoma. Dr. Ewing's opinion was that it was a sarcoma from the beginning with an unusually large amount of osteoid structure which failed to reveal its true nature in the portions removed at the time of exploratory operation. In the light of further experience I am inclined to agree with Dr. Ewing, although, by so doing, one is forced to conclude that in certain cases it is impossible to determine the nature of a bone tumor from the histological examination alone. In other words, too much stress should not be laid upon a negative microscopic examination of tissues removed at exploratory operation. The pathologist is often handicapped by the fact that too small a portion of the tumor has been removed or that it was not removed from the right place to show the characteristic structure of the tumor in question; and he is obliged to make a negative report as regards malignancy. The negative pathological report should always be carefully weighed with all the other evidence, especially the clinical history of rapid or slow growth, the size and consistence of the tumor, and the roentgen-ray evidence. If all these point to a malignant tumor, then the surgeon who has the responsibility of the treatment of the patient, may be justified in ignoring the negative pathological report and treating the patient accordingly. Fortunately, these cases are the rare exceptions. In the great majority of cases, the microscopic diagnosis is confirmed by the subsequent course of the tumor; other-

wise, there would be little value in the biopsy or exploratory operation. It is still rarer to find a case in which a positive report of sarcoma was made, and in which the later developments showed that the condition was one of myositis ossificans. The histological picture of a rapidly developing myositis ossificans so simulates that of an osteogenic sarcoma that the most experienced pathologists are sometimes unable to differentiate the two conditions. The following case furnishes a most striking illustration.

CASE 2. MYOSITIS OSSIFICANS OF QUADRICEPS MUSCLE OF THIGH CLOSELY SIMULATING PERIOSTEAL SARCOMA CLINICALLY, ROENTGENOLOGICALLY AND MICROSCOPICALLY.

R. D., male, aged nineteen years, had always been in good health until November 6, 1923, when he received an injury (charley horse) to his femur, while playing football. About one week later the same leg was again injured in another football game. No pain was felt except on deep pressure, but the muscles "felt tight" and the leg had the appearance of being bruised. He consulted Dr. N. W. Sherwood of the Scott and White Clinic, Temple, Texas, who performed an operation on November 21, 1923. On cutting through the muscles of the right thigh, about twelve ounces of amber-colored, thin fluid were evacuated; there was no evidence of blood-clot or hematoma. The exploring finger felt several hard, irregular places in the wall of this fluid-containing cavity which extended for a distance of ten inches along the length of the femur. Some half-inch thick tissue from the surface of the bone was dissected. This had the appearance of a sarcoma; there was no capsule and the invasion spread in various directions through the muscle and under the periosteum.

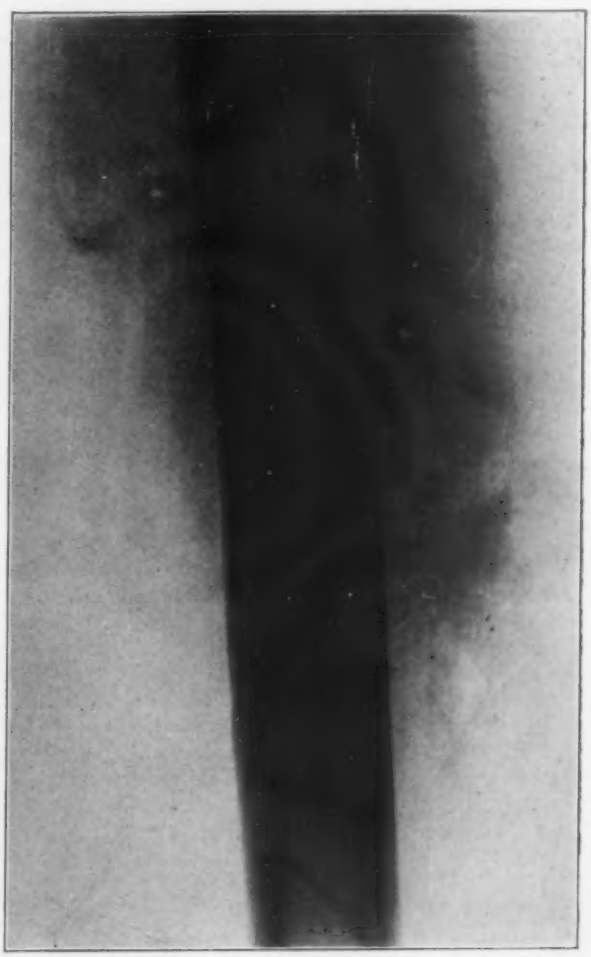

FIG. 1

Case 2, R. D. Acute myositis ossificans following recent trauma to the femur. Microscopical picture very closely resembled that of periosteal osteogenic sarcoma.

FIG. 2

Case 2, R. D. Photomicrograph of same case.

Pathological report (Pathologist of Scott and White Clinic): "Gross pathology: Very fine elongated mass of tissue, tubular in outline, about one centimeter in diameter, removed from thigh and about region of middle third. Cross section through tubular mass shows a dense whitish-colored tissue, with very small irregular ovoid-shaped areas of a pale brownish-color scattered throughout. Microscopic examination shows a dense fibrous stroma infiltrated with spindle-shaped polychromatic cells. These cells are very compact in areas and are producing osteoid tissue. The osteoid tissue formation shows a high degree of differentiation. As osteoblasts in the bone-forming areas show irregularity in size and are polychromatic, and as the bone-forming process shows some deviation from normal, this neoplastic growth is placed in the osteogenic sarcoma group. The cells of this growth are spindle in shape with cystoplasm elongated into fibrilla. As the bone-forming process shows high differentiation, it is classed as being of fair degree of malignancy. Some areas show presence of cartilage. Final diagnosis: osteochondrosarcoma, fair degree malignancy." This diagnosis was confirmed at the Mayo Clinic Laboratory.

The patient was referred to me on December 11, 1923, and was admitted to the Memorial Hospital. Physical examination at this time showed a well developed, well nourished male. Examination of extremities was negative; except on the anterior surface of the right thigh there was an incision about twelve centimeters long which had healed, with the exception of a small opening in the center in which Dakin tubes had been inserted. Palpation revealed a diffuse swelling on the anterior aspect of the thigh, firm

in consistence, almost of bony hardness, beginning one inch above the scar and extending below the lower end of the scar, and beginning at about the middle of the medial side and extending to the middle of the outer side, or, extending around two-thirds of the circumference of the leg. The swelling was well outlined at the upper end, tapering off to the periosteal level at the lower end; one nodule projected from the inner aspect of the growth.

Placing greater reliance than I should have upon the positive pathological diagnosis of osteosarcoma, I believed at first that the condition was one of periosteal sarcoma.

Roentgen-ray report by Dr. Herendeen, December 14, 1923: "Films of femur reveal presence of changes in the periosteum through the middle third on the external surface suggesting the presence of an early rapidly growing periosteal sarcoma."

Pathological report by Dr. Francis Carter Wood, December 15, 1923: "I have examined the two slides which you left here this morning, and it seems to me that a diagnosis of sarcoma is warranted from the specimens.

"There is newly forming bone and cartilage in both specimens in the neighborhood of muscle fibers. I have examined my stock of slides of myositis ossificans, of which I have a number of cases, but do not find any great resemblance between the two. Certainly the case should be treated clinically as a malignant tumor until it is proved otherwise."

Pathological report by Dr. James Ewing, December 14, 1923: "Sections (taken at operation in Texas) show productive inflammation of the type of myositis ossificans. There is very active growth of bone trabeculae through the muscle tissue, and some islands of newly-formed cartilage. One section comes from the edge of a hematoma, and is lined by lamellae of fibrin. About some trabeculae the cell growth is extremely active and there is considerable hyperchromatism, but the process lacks the distinctive features of sarcoma of bone.

"Diagnosis: myositis ossificans, very cellular; bone repair."

Pathological report by Dr. F. B. Mallory of Boston, Mass., December 22, 1923: "Sections show a reparative lesion following traumatic injury to bone and muscle with displacement of periosteal cells. The periosteal fibroblasts involved in the reparative process produce bone callus, and under certain conditions (motility of parts) cartilage. There is no evidence of any new growth.

"The lesion would ordinarily be classed as myositis ossificans."

While waiting for these various reports, the tumor showed no tendency to increase in size and there was no pain. In the belief that the condition was one of myositis ossificans, all treatment (he had received six injections of the mixed toxins and one radium-pack treatment of 20,000 millicurie hours over two areas) was suspended and the patient was allowed to go home. The swelling, which had markedly diminished in size during his ten days' stay at the Memorial Hospital, later entirely disappeared. The patient is in excellent health at the present time, nearly four and one-half years later, thus confirming the diagnosis of Dr. Ewing.

CASE 3. MYOSITIS OSSIFICANS CLOSELY SIMULATING PERIOSTEAL SARCOMA.

J. R., male, aged nine years, fell striking his shoulder on a hard floor. A swelling was noticed almost immediately afterward. This increased in size and was accompanied by a temperature of 101 or 102 degrees. An exploratory operation was performed by Dr. J. F. Black of White Plains, N. Y., which revealed a tumor of the upper end of the humerus, apparently springing from the periosteum. A microscopic section was examined by the pathologist of the White Plains Hospital, whose diagnosis was that of osteogenic sarcoma. These sections were later examined by Dr. Ewing and Dr. Wood who concurred in the diagnosis of osteogenic sarcoma.

At the time of the patient's admission to the Hospital for Ruptured and Crippled, in February, 1927, physical examination showed a very large, rounded tumor, apparently a periosteal sarcoma of the upper portion of the left humerus. There were two large open wounds, the site of the recent operation. Roentgen-ray examination revealed a

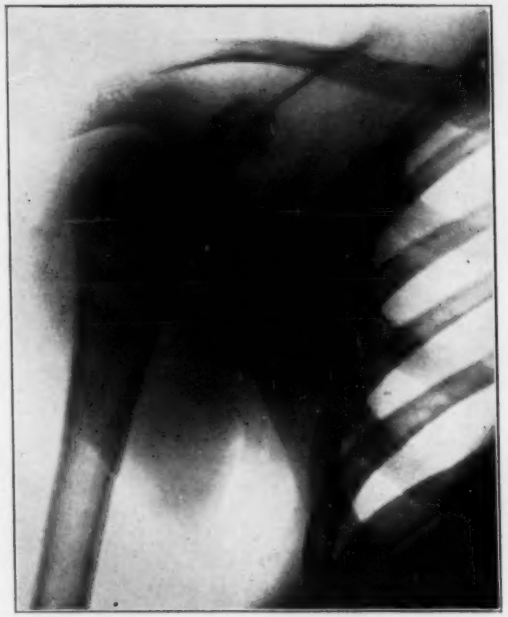

FIG. 3

Case 3, J. R. Acute myositis ossificans (following trauma) closely simulating periosteal sarcoma. Later diagnosis made from clinical, roentgenological and microscopical evidence. Subsequent developments: three weeks later stereoscopic picture showed rapidly developing new bone within the muscles and having no connection with the humerus. Patient well one year later.

FIG. 4
Case 3, J. R. Feb. 7, 1927.

FIG. 5-A

FIG. 5-B
Case 3, J. R. Feb. 7, 1927.

Case 3, J. R. Feb. 7, 1927.

condition which closely simulated that of a rapidly growing periosteal sarcoma.

The patient was treated for two weeks with systemic injections of the mixed toxins of erysipelas and bacillus prodigiosus. The tumor decreased to nearly one-half of its original size; but at the same time there developed a hard, bony swelling just behind the deltoid and also above the scapula. The ward in which the patient lay was under quarantine, and it was impossible to take any further roentgenograms until two weeks later. Then the picture showed a large area of new bone formation that at first was believed to be an osteogenic sarcoma arising from the humerus; however, on stereoscopic examination, it was revealed that the new bone had no connection with the humerus, but had originated in the muscles about the shoulder. This evidently was a striking example of acute traumatic myositis ossificans very closely resembling periosteal sarcoma both clinically and microscopically. No further treatment was given, and the patient has remained in excellent condition (June 1928).

FIG. 6
Case 3, J. R. Feb. 28, 1927.

These two cases are the most instructive that have come under my personal observation; and in spite of a large experience in bone tumors, I failed to make a correct diagnosis at first. In both cases this failure was due to placing too much confidence in the microscopic appearance of the section, and too little weight upon the clinical history and the roentgen-ray findings. In both cases the tumor developed within less than two weeks to a considerable size,—a little too rapidly for an osteogenic sarcoma. In one case, the roentgenogram of the femur should have made clear the diagnosis of myositis ossificans. Here we had an extensive tumor of the femur developing in two weeks, involving no less than eight or ten inches of the anterior portion of the femur or thigh. The sharp periosteal line was intact,—an important diagnostic sign which many years ago I pointed out was almost pathognomonic of myositis ossificans and very rarely found in sarcoma. In sarcoma, the periosteal line is almost always irregular, broken and indented. Again, the swelling or tumor was confined entirely to the anterior portion of the femur and did not tend to extend all the way around the bone as is the rule in periosteal sarcoma. All this clinical and roentgen-ray evidence pointed strongly against a diagnosis of periosteal

FIG. 7
Case 3, J. R. Photomicrograph.

sarcoma. The various pathologists who had examined microscopic sections were almost equally divided in their opinions, a number of them pronouncing it to be osteogenic sarcoma, and others, myositis ossificans. In this case, the responsibility of the surgeon was great and his position a difficult one; for if the condition were one of periosteal sarcoma, immediate amputation would have been indicated as offering the only hope of saving the patient's life. After carefully weighing all the evidence presented, in a number of days I finally became convinced that the condition was one of myositis ossificans and needed no treatment. The patient made a very satisfactory recovery, and is now in good health, without any disability, four and one-half years later.

In the second case, there was no conflict of pathological opinions; all agreed that it was a case of osteogenic sarcoma. The roentgenogram was not absolutely characteristic of osteogenic periosteal sarcoma, but it was more nearly like that than anything else. The clinical history was rather against a diagnosis of sarcoma in that a tumor of considerable size developed almost immediately after a fall or local injury; and this swelling was accompanied by considerable temperature (102 to 103 degrees) which continued

for several days. The swelling and temperature favored the diagnosis of osteomyelitis, which was made by Dr. J. F. Black of White Plains, New York, who had charge of the patient. Exploratory operation, however, revealed no pus and no evidence of osteomyelitis but rather a mass of tissue the size and shape of a mushroom, two inches in diameter and three-eighths of an inch thick, which was apparently attached to the periosteum of the humerus in the region of the deltoid. This was peeled off and removed. No suppuration followed the operation and the temperature fell. The sections were examined by three pathologists all of whom made a diagnosis of osteogenic sarcoma. When the final stereoscopic picture showed the large bony tumor to be situated in the muscles and having no connection with the humerus, and a diagnosis of myositis ossificans was made, all treatment was suspended. The condition slowly subsided. The bony tumor never entirely disappeared, but the patient has good function of the arm now, over a year later, and is in perfect health.

This case illustrates the importance of weighing every bit of evidence before making a final diagnosis. It might seem that the early rise of temperature should have made the diagnosis of an inflammatory bone tumor easy; but, on the other hand, we not infrequently find a well marked temperature in cases of true sarcoma, especially in rapidly growing sarcoma. If, however, we study the cases of sarcoma with temperature, we find, according to my own experience, that in nearly all cases the temperature does not occur in the very early stages, and not until the tumor has shown signs of breaking down, degenerating with absorption or in rapidly metastasizing tumors. Therefore, in this case, the marked rise in temperature almost immediately after the injury should have made us very doubtful that the condition was a neoplasm.

Case 4. Osteogenic Sarcoma of Femur Closely Simulating Osteomyelitis. I. L., male, aged twenty years. In March, 1921, this patient's left leg was caught in the door of a subway train, and his thigh was severely squeezed. Nothing unusual was noticed until three days later when he felt severe pain in the injured thigh just below the great trochanter; this was intermittent at first, keeping him in bed for a few days at a time, but later the attacks became more frequent. A swelling was noticed, which gradually increased in size. The patient was admitted to the Jewish Hospital of Brooklyn on July 25, 1923, where an operation (osteotomy and curetting of bone) was performed on August 7, 1923. A microscopic examination was made, and the report was as follows: "Specimen consists of degenerated soft tissue in which there are imbedded small pieces of sclerotic bone tissue. Microscopic diagnosis: osteomyelitis of left femur." A section of this specimen was examined by Dr. Jeffries, whose diagnosis was that of productive osteitis. Dr. Ewing who also examined a section, concurred in the diagnosis and said that one edge of the specimen showed a slight suspicion of possible neoplasm, but not enough on which to make a diagnosis. Roentgen-ray examination made in 1923 showed nothing at all suggestive of sarcoma; there was a marked thickening of the femur with sclerosing of the bone, typical of a chronic sclerosing osteitis. Physiotherapy treatment was begun in the latter part of 1924.

On March 13, 1925, the patient was admitted to the Hospital for Ruptured and Crippled. A roentgenogram taken at this time showed that certain changes had occurred since the last picture was made: the bone was larger and thicker than it was at that time; the density seemed not quite so marked; instead of the periosteal line of the bone being

FIG. 8

Case 4, I. L. Lesion of femur treated for three years as chronic osteomyelitis, which diagnosis was confirmed by biopsy and microscopical examination. Later developed clinical evidence of malignancy (this confirmed by further exploratory operation). Later microscopical diagnosis: osteogenic sarcoma. Almost complete disappearance under toxins and radium. Remained well for one and one-half years and then developed multiple metastases. Died six months later.

intact, there were a few erosions in one area—a few indentations in the normal outline; apparently there was a small amount of new bone production beyond this normal line. The picture, however, did not permit one to make a diagnosis of sarcoma, although it was more suspicious of sarcoma than the earlier pictures. A few months later, no improvement in the condition having been noted, the patient was admitted to Dr. Whitman's service (Hospital for Ruptured and Crippled) and I was asked to see the patient. The clinical appearance of the tumor, as well as the roentgen-ray evidence, in my opinion, was strongly suggestive of a neoplasm rather than an osteomyelitis. An exploratory operation was performed by Dr. Whitman on March 16, 1925, which revealed soft, vascular tumor tissue that had broken through the muscle. This was examined microscopically by Dr. Jeffries, and pronounced a mixed cell sarcoma. Dr. Ewing also examined a section, and he reported as follows: "osteogenic sarcoma, polygonal cell, malignant". Amputation was advised and refused.

The toxin treatment was begun on April 1, 1925 and continued in gradually increasing doses for two months. At the end of six weeks' treatment, the circumference of the thigh had diminished two inches, and the patient's general condition had shown marked improvement. Low-voltage roentgen-ray treatment was begun at the Memorial Hospital by Dr. Herendeen; from May 7, 1925 until November 13, 1925, the patient received seven exposures of sixty minutes each.

The patient remained well for about one year and then began to have vague pains in different parts of the body, especially in the affected femur. Roentgen-ray examination was negative. Later on, however, he developed evidence of metastases in the lungs, retroperitoneal glands, and various other parts of the body. In spite of further treatment (toxins and radiation), the condition gradually grew worse and he died a few months later.

Case 4 illustrates well the difficulty and sometimes the impossibility of making an early diagnosis even with the aid of a biopsy and microscopic examination supplementing the clinical and roentgen-ray evidence. In this case, we have a young man with a more or less diffuse swelling or enlargement of the femur following shortly after a local trauma. The condition progressed slowly and was accompanied by some pain and changes in the bone and periosteum which were characterized by increased density in certain areas and erosion or destruction in others. The roentgenograms resembled more the bony changes seen in osteomyelitis than in sarcoma.

The patient was able to continue his work for two and one-half years when a biopsy was performed; the gross appearance was that of osteomyelitis. A microscopic section was examined and pronounced chronic osteitis with no evidence of malignancy. The trouble continued to progress slowly and the patient was admitted to the Hospital for Ruptured and Crippled nearly four years after the first evidence of the trouble. In this case also the condition was regarded as that of an osteomyelitis, which diagnosis was confirmed by the roentgenograms. A second exploratory operation was performed, a few weeks after which I first saw the patient. At this time, the clinical roentgen-ray appearances were strongly suggestive of a sarcoma. A third exploration was performed, and the diagnosis of sarcoma was confirmed by microscopic examination. The picture, both clinically and roentgenologically, had changed rapidly within a few weeks. By this time such a large portion of the femur had become involved that I believed even hip-joint amputation offered little hope. However, I urged an amputation, to be followed by prophylactic toxin treatment. This the patient refused, and he was then given large doses of the mixed toxins of erysipelas and bacillus prodigiosus injected both into the tumor and systemically. He showed marked improvement, and a few weeks later he entered the Memorial Hospital where he received a cycle of roentgen-ray treatment. Within two or three months the disease was apparently under complete control; the patient had gained thirty pounds in weight, and had returned to his work. Unfortunately, the improvement was so striking that the toxin treatment was discontinued early instead of being kept up for six months to a year. At the end of one and one-half years, the patient returned complaining of pain in the thigh. This was relieved by roentgen-ray treatment. A few months later he complained of vague pain in different parts of his body. He developed widely distributed metastases in his lungs, abdomen, and spine, and died in about five months. Although Dr. Ewing's microscopic diagnosis in this case was that of osteogenic sarcoma, the remarkable sensitiveness to radiation and toxins, and the absence of new bone formation, inclines me to believe that this case should be classified as an endothelioma type of sarcoma.

In another case, that of a young man who was observed at almost the same time as Case 4, there was likewise a tumor or swelling of the femur, which had been diagnosed clinically as an osteomyelitis, and had been operated upon six months before at another hospital, and the diagnosis apparently confirmed by macroscopic and microscopic examination. At the time of his admission to the Hospital for Ruptured and Crippled, the clinical and roentgen-ray evidence seemed to warrant a diagnosis of osteomyelitis. The characteristics of the tumor changed markedly in two months; and roentgenograms taken at that time revealed a condition that was suggestive of sarcoma of the endothelioma type. The patient was transferred to my service, and a hip-joint amputation was performed by Dr. Bradley L. Coley. Prophylactic toxin treatment was given for three

months. The patient remained well for two years and then developed pulmonary metastasis. He is now in a hopeless condition.*

The cases just cited prove conclusively that there is a group of tumors of the long bones in which it is impossible to make a positive diagnosis in the early stages even with the aid of a biopsy and the most expert pathologic opinion. Fortunately this group of cases is very small, in our own experience representing not more than two or three per cent. of the cases observed. If they represented the average, rather than the very rare and exceptional case, then one might well despair of making a diagnosis in long bone sarcoma sufficiently early to be of benefit to the patient. These cases bring up the question, whether it might not be possible, in at least some of the cases, that the condition in the early stages was merely an inflammatory one; and that later on this inflammatory focus furnished a favorable site for the development of a true neoplasm? It is generally admitted that chronic inflammatory trouble elsewhere—*e.g.*, in the breast, may predispose to the development of a malignant tumor. I am not prepared to venture a definite opinion but I believe that in the majority of the cases just cited, the original condition was sarcoma of an unusually slowly developing type; that the reaction upon the bone closely simulated that of osteitis; and that later on, as the growth became more rapid, the changes in the bone and in the tumor itself became more characteristic of sarcoma. It seems to me that it is more reasonable to suppose that in certain cases of bone sarcoma, the histological appearances of the tissue so closely simulate chronic osteitis that the pathologist is unable to differentiate them, than to suppose that the tumor was an inflammatory swelling on one day and a true neoplasm a few days or months later. This theory was, I feel quite sure, the correct one in Case 1 as well as in the example cited immediately thereafter; and yet, in some of the other cases, I believe the weight of evidence points in favor of an originally benign inflammatory condition, which later formed a favorable site for the development of a true neoplasm of the bone. In this category I would place the following two cases:

(1) A periosteal sarcoma of the femur in a man aged forty-eight years, who had had a fracture of the mid-femur at the age of four and again at the age of eleven. There was more or less chronic osteomyelitis at the site of the fracture for thirty odd years, which finally developed into a rapidly growing and highly malignant periosteal sarcoma. A hip-joint amputation was performed, followed by a prolonged course of prophylactic toxin treatment. The patient is well at present, eleven and one-half years since the treatment was begun. (For full report, see Archives of Surgery, XIV, 91, January, 1927, Case No. 18.)

(2) A young man aged nineteen years, with a history of having had a bony tumor removed from the outer condyle of the femur by Dr. John B. Deaver, ten years previously, which, on microscopic examination was pronounced a benign osteoma. About eight years later there was an apparent local return of the tumor; this grew rapidly. I then amputated for a periosteal sarcoma of the sclerosing type. The patient was given a course of prophylactic toxin treatment. He remained in good health for three years and then developed pulmonary metastases which proved fatal.

In the two cases just cited, I think we have ample proof that the

*I believe that the toxins should have been given for a much longer period.

original condition was one of benign chronic osteitis or osteomyelitis or osteoma, and that later a malignant tumor developed at the same site.

Osteitis Fibrosa Cystica. This condition originally described by Mickulicz[7] has become well recognized as a definite type of bone tumor of some obscure inflammatory origin. In most cases the age of the patient and the clinical history of slow development, supplemented by roentgenograms, should enable one to differentiate the condition from one of sarcoma. It occurs usually in young children of from ten to twenty years of age; and I have observed one case in a child seven years of age (It is true that sarcoma likewise may occur at this early age). While there may be a history of antecedent trauma this is not nearly as frequent as in sarcoma. The disease most often originates in the diaphysis of the bone, the humerus and femur being the most common sites. The origin may be quite obscure, owing to the absence of early pain which is so characteristic of sarcoma. The disease may progress unrecognized to such an extent that a spontaneous fracture may be the first symptom observed. In other cases, a bony swelling is noted, usually fusiform if in the mid-shaft of the bone; and the roentgenogram shows evidence of marked destruction of the bone with a tendency to the formation of multiple cysts. There is, as a rule, little tendency to new bone formation. The spontaneous fracture may unite under fixation of the limb; and cases are on record of reunion of a second and a third fracture. The disease is of very slow progress, and may result in a spontaneous cure, or may be apparently cured by roentgen-ray treatment. In some cases it may become generalized without the quality of a malignant tumor. In certain cases it may be very difficult to distinguish from a sarcoma.

Delbet at the Société de Chirurgie, Paris, in 1900, reported one of the most instructive cases. Here the condition was interpreted by Jalaguier, Broca, Quénu, and Delbet himself[8] as one of hypertrophied callus, and by Poncet as a giant-cell tumor. In another case described in the thesis of Potel[9], several surgeons had advised amputation at the shoulder. Jaboulay[10] contended that it was a benign lesion; and the child was cured by simple measures. Nové-Josserand and Tavernier[11] state that the first bone cyst observed by themselves had been regarded from a histologic point of view as a malignant sarcoma, and had been permanently cured by simple curettage. One of these writers many years ago resected the inferior extremity of the tibia for a tumor, believed to be a sarcoma, but which proved to be a fibroma. They call attention to the fact that osteitis fibrosa cystica may not only closely simulate a giant-cell tumor but a malignant sarcoma of the bone as well. In one of my own cases of a cyst of the humerus, I believed I was dealing with a simple cyst. Roentgen-ray examination showed no evidence of a tumor. The patient was five years of age, just the age which would favor a diagnosis of cyst or osteitis fibrosa cystica. I operated and removed a small piece, three-quarters of an inch in size, from the bony shell, and found a cavity containing nothing but clear, straw-colored fluid; there was no evidence of any tumor present. A

histologic examination of the wall section was made by Dr. Ewing and he pronounced it a giant-cell tumor. Some surgeons advised resection with bone graft, inasmuch as there was but a thin shell of bone left over a portion of the shaft of the humerus for a distance of two or two and one-half inches. I decided to await developments; and in about three months there was an increase in the size of the swelling and the cavity, as revealed by the roentgen-rays, showed a characteristic picture of giant-cell tumor with trabeculae. I then treated the lesion with radium in the form of a pack, and injections of the mixed toxins given for a prolonged period. The condition slowly improved. New bone began to form, there was no pathologic fracture, and the child made a perfect recovery and remains well ten years later

Nové-Josserand and Tavernier[12] state that while both conditions, osteitis fibrosa cystica and giant-cell tumor, are slow in developing, and are characterized by limited bone destruction without affecting the general health and without tendency to generalize, the cysts show a preference for the superior extremity of the humerus and femur, where giant-cell tumors are rarely found. Furthermore, the cysts occur at a younger age, from ten to twenty years, whereas giant-cell tumors rarely occur under twenty years of age. In my own case just cited, the patient was a child of five years with a giant-cell tumor which had occurred in the upper end of the humerus; but this is an exception to the general rule.

On exploration, the macroscopic appearance of osteitis fibrosa cystica differs decidedly from that of giant-cell tumor. The tissue is nearly always white or grayish-white in color, whereas in giant-cell tumor it is red or wine-colored or reddish gray. On the other hand, Stewart of Leeds has described a case of white giant-cell tumor which, without microscopic examination, might easily have been mistaken for an osteitis fibrosa cystica. Nové-Josserand and Tavernier have observed a case very similar to the one reported by Morton and Duffy[13], in which an osteitis fibrosa cystica destroyed practically the entire bone and took on the true characteristics of a locally malignant condition.

In most cases the roentgenogram is of material help in making a diagnosis between giant-cell tumor and osteitis fibrosa cystica or bone cyst; but in my case, it was of no aid; in fact, it pointed strongly to a cyst and yet the condition proved to be one of giant-cell tumor. If a biopsy is performed, and I believe one should be performed in all doubtful cases, this should nearly always settle the diagnosis; but there are on record a few cases in which even after biopsy and microscopic examination the diagnosis was not positive.

Fortunately all three of these conditions are usually benign; and the surgeon is justified in continuing conservative treatment. In a few cases the later developments may show that the diagnosis of benign osteitis fibrosa was wrong; and the clinical and roentgen-ray features gradually change in character and take on the characteristic aspects of a malignant bone tumor.

CASE 5. LESION OF TIBIA TREATED FOR NEARLY NINE YEARS AS AN OSTEITIS FIBROSA CYSTICA. AMPUTATION. MICROSCOPIC DIAGNOSIS: OSTEOGENIC SARCOMA.

M. G., female, aged thirteen years, was first admitted to the Memorial Hospital, service of Dr. Quick, on April 17, 1919. Six years previously, or in 1913, the patient had suddenly felt pain in the upper portion of the right tibia, and a swelling developed almost immediately after. The pain lasted for a few days and then subsided, leaving behind a small lump in the anterior portion of the tibia. There was no further trouble until April, 1919, or six years later, when the patient had a similar attack of sudden severe pain associated with swelling.

Physical examination, at the time of her admission to the hospital in April, 1919, showed a swelling of the anterior and upper portion of the right tibia, measuring nine by five inches. There was some tenderness on deep pressure. A clinical diagnosis of benign osteosarcoma was made. Roentgenologic diagnosis: osteitis fibrosa cystica.

A course of roentgen-ray treatment was given.

Follow-up notes:

March 18, 1920: Condition improved as shown by lessening of the size of the areas involved and increased amount of calcification.

November 11, 1920: No definite well marked changes.

May, 1921: Patient feeling very well.

June 30, 1926: Continued improvement.

June 22, 1927: Very little change noted.

August 18, 1927: Definite increase in the pathologic condition over the upper part of the tibia. Advise radium-pack treatment.

August 22, 1927: Radium-pack treatment of 14,000 millicurie hours.

November, 1927: Radium-pack treatment of 12,000 millicurie hours.

The patient was shown at the Memorial Hospital Staff Conference in the latter part of January, 1928, and an amputation was advised. This was performed by Dr. Quick on February 2, 1928. The specimen was examined microscopically by Dr. Ewing, whose diagnosis was that of osteogenic sarcoma with large polyhedral cells*.

In this case, a girl aged thirteen, had a condition which was diagnosed as an osteitis fibrosa cystica, and which under radiation showed marked improvement. The condition remained quiescent for nine years, and then last fall it began to show evidence of renewed activity, taking on the clinical features of malignancy with a corresponding change in the roentgenograms; not improving under further radiation, an amputation was performed. On microscopic examination, Dr. Ewing found a true neoplasm (sarcoma). I have observed another very similar case.

Therefore, I believe we must admit the possibility of a true sarcoma developing upon an old osteitis or an old osteoma; and if this is true it shows the importance of frequent observation and frequent roentgen-ray examination of cases of chronic osteitis. Should such examination reveal evidence of marked change in the limb, then the question of malignancy must be considered; and further evidence, perhaps by biopsy, should be secured.

I have long believed that all sarcomas are due to some extrinsic cause, some unknown microbic infection, and these cases that I have just related would seem to favor this theory.

Syphilitic Osteitis or Osteomyelitis. Syphilis of the bone is now much easier to differentiate from neoplasm of the bone than it was a genera-

*I am indebted to Dr. Quick for permission to publish this case.

tion ago. Before the discovery of the roentgen-ray and Wassermann methods, I well remember that most sarcoma of the bone were first treated with "mixed treatment" (mercury and iodides of potash), before one ventured a diagnosis of sarcoma. Unfortunately in a few cases marked improvement followed such treatment, and the surgeon, believing the condition improved, lost valuable time and with it the chance of saving the life of his patient by early operation. At present, with the aid of the roentgen-ray and the Wassermann reaction, together with the clinical history of longer duration and multiplicity of lesions, a correct diagnosis can usually be made at a fairly early stage of the disease.

It is rarely that one finds a single bony lesion in syphilis; and in addition to other enlargements of the bones, one will find other evidences of syphilis. We have already mentioned the favorite sites of sarcoma of the long bones. In syphilis there is a certain predilection to the tibia (shaft) and the clavicle. The bony enlargement differs clinically and roentgenologically from sarcoma. While it may have the same fusiform shape, it differs in consistence; it is much harder than is the case in periosteal sarcoma. The roentgenogram shows that the enlargement of the bone is due to the formation of very dense, ivory-like new bone which surrounds and involves the whole circumference of the shaft instead of being more localized as in sarcoma and especially in myositis ossificans. In syphilis the roentgenogram shows neither the sharp, intact, periosteal line that is found in myositis ossificans nor the eroded and often stripped-up periosteum seen in periosteal sarcoma; but as Nové-Josserand and Tavernier[14] have well described it, it is "nette", irregulated and bosselated. The bony enlargement in syphilis includes the entire cortex, dense and opaque, while in periosteal sarcoma, the roentgenogram suggests new bone superimposed upon the original bone and not being a part of it. Furthermore in the later stages, in periosteal sarcoma, this new bone involves all the layers, the periosteum, cortex, and marrow.

I have observed a case of lesion of the ulna near the elbow, in a woman aged thirty-five years, married, and with a negative clinical history concerning specific disease. The duration of the trouble and the pain pointed rather to sarcoma; the roentgenogram had been interpreted by expert roentgenologists as probably sarcoma; and radium treatment had been begun in the belief that it was this condition. In my opinion, the roentgen-ray evidence pointed more to a condition of chronic osteitis. I advised an exploratory operation, which was performed, and revealed no evidence of a tumor. Macroscopically the tissue resembled that of osteitis, and this diagnosis was confirmed by a microscopic examination. A Wassermann test was made and reported four plus. Under antiluetic treatment the patient made a good recovery.

In certain cases we may find a lesion of the bone quite limited to the neighborhood of a joint in which there has been no bone production but an area of bone destruction. The roentgenogram will not help us to distinguish whether this is an osteosarcoma of central origin or a syphilitic

lesion in the nature of a gumma or even a tuberculous lesion. In such a case, the first thing to do is to make a Wassermann examination and try to find other evidence of syphilis; and if still in doubt, then to perform a biopsy.

Chenelot[15] reported a group of cases which he described as *pseudo sarcome syphilitiques*, which closely resembled periosteal sarcoma both clinically and macroscopically. He cites an example of a man who had two tumors, one of the clavicle and one of the scapula (*omoplate*), which were operated upon several times by Leriche. The condition was strongly suggestive of a fibrosarcoma, periosteal, without any areas of necrosis. The sections of the tumors removed at operation were interpreted at one time as sarcoma and at another as giant-cell tumor, and at another time as simple inflammation, until finally, the syphilitic nature of the condition was recognized by Dor. Under specific treatment a prompt recovery took place. In this case (which was cited by Nové-Josserand and Tavernier) there was a multiplicity of lesions, while it is extremely rare for sarcoma to originate in two or more places in the early stages; furthermore, the continued recurrences without evidence of metastases should have cast doubt upon the diagnosis of sarcoma, while the indefinite microscopic picture should have strengthened this doubt.

Tubercular Osteitis or Arthritis. Like syphilitic lesion of the bone, tuberculosis of the bone and joints is much less frequently mistaken for neoplasm now than formerly. Still it is the not uncommon experience of surgeons who see many cases of bone tumor to find a considerable proportion of these cases treated elsewhere, and often at well known hospitals, by immobilization in the belief that the condition is one of tuberculosis. The clinical history of the case combined with a careful physical and roentgenologic examination should enable one to make a diagnosis in the great majority of cases. The age of the patient does not help much in differentiating the two conditions, as both sarcoma and tuberculosis occur most frequently in young adults, although tuberculosis is more often found under the age of fifteen years than is sarcoma. The rate of development is of great importance; sarcoma develops much more rapidly than does tuberculosis. Pain is found in both conditions, although in sarcoma it is usually more persistent, while in tuberculosis it is not only less severe but is usually controlled by immobilization of the joint, which procedure has little effect upon sarcoma. Antecedent trauma may be noted in both conditions, but it is more often found in sarcoma in which it is more promptly followed by pain and swelling. In sarcoma, after the swelling has reached an appreciable size, the superficial veins become dilated, while in tuberculosis the skin is paler than normal. Atrophy of the muscles above the swelling is more noticeable in tuberculosis than in sarcoma; but the diagnosis should be made before these late symptoms develop. The location of the swelling gives important evidence. In sarcoma it almost always begins in the diaphysis, although, in giant-cell tumor it may involve the epiphysis and may before long extend almost into the joint. In tuberculosis the swelling

begins in the epiphysis and involves the joint fairly early. Hence, a good roentgenogram should in most cases make the diagnosis easy. The swelling itself differs from sarcoma. It is softer in consistence and often semi-fluctuating. The joint is frequently involved. The roentgenogram often shows multiple lesions and many erosions. In spite of all these characteristic features, we find an occasional case in which the diagnosis is extremely difficult. I would refer the reader to the two cases of Beye[16] quoted in my paper on Primary Malignant Tumors of the Long Bones[17].

In cases in which the evidence is conflicting, Nové-Josserand and Tavernier[18] advise waiting for a time for the evolution of the disease which is quite different in the two conditions.

Tubercular osteitis usually improves quickly under proper treatment, while sarcoma would continue to grow worse under this same treatment. In view of the fact that the latter condition, under certain circumstances, has periods of quiescence and even of apparent regression, Nové-Josserand and Tavernier state that it is always important to wait for a sufficient time in which to take advantage of this symptom. Personally, I do not agree with this advice for the reason that, if in the end the lesion should prove to be sarcoma, much valuable time will have been lost before the proper treatment can be instituted. In my opinion, it would seem far wiser to perform an early biopsy and make a diagnosis at a time when we have a far greater chance of saving the life of the patient. Should the condition prove to be tuberculosis, little harm will have been done. The type of tuberculosis which most closely simulates sarcoma is the so called para-articular tuberculosis which has not yet involved the joint. The roentgenogram will be of little aid in differentiating this condition from giant-cell or central sarcoma. In such cases, if the diagnosis is still in doubt I believe then an exploratory operation is indicated.

If the condition should prove to be that of giant-cell tumor, then the surgeon should be prepared to proceed with a complete curettage, following this with an application of pure carbolic acid or zinc chloride to the cavity, and later, injections of the mixed toxins of erysipelas and bacillus prodigiosus given systemically. If the condition should prove to be one of malignant sarcoma of the endotheliona or round-cell type in which early conservative treatment (toxins and radiation) offers some hope of saving the limb, then this treatment can be applied when there is a far better chance of success than had one waited until the "evolution of the disease" had rendered the diagnosis positive.

While tuberculosis of the long bones nearly always occurs in the region of the epiphysis, in certain cases it may be found in the diaphysis. This usually occurs in the bones of the hands or feet, and especially in the metacarpal or metatarsal bones. In such cases the diagnosis is very difficult, even with the aid of the roentgenogram. I have observed one such case in a child, aged eighteen months, with a history of recent trauma; a swelling soon developed involving a large part of the diaphysis of the third metatarsal bone. The condition had been diagnosed by a professor of

surgery in a distant city as one of sarcoma. Personally I believed it to be probably a sarcoma, but possibly tuberculosis. The roentgenologic examination was of little help. I did an exploratory operation and found an osteitis without necrosis which proved to be tuberculous. The child made a good recovery and is well now, three years later. Had the condition been one of osteogenic sarcoma, it would have been fatal, in all probability, to have waited for the "evolution of the disease" to settle the diagnosis. The very early age of the patient in this case favored a diagnosis of tuberculosis, although I have observed a sarcoma of the scapula in a child aged three months.

Chondroma or Enchondroma. The differential diagnosis between sarcoma and chondroma may be very easy or extremely difficult. In those cases in which the disease is multiple, the diagnosis is easy. In those in which the tumor is of very long duration, with a tendency to remain dormant or to increase very slowly, the diagnosis is not difficult. On the other hand, we find a very large group of cases in which the growth has been fairly rapid for a benign chondroma and which, clinically, point to a diagnosis of osteochondrosarcoma. If an exploratory operation is performed in these cases, in a considerable number the microscopic examination will fail to settle the diagnosis for the reason that one pathologist will call the tumor a chondroma, and another of equal experience will call it a sarcoma, leaving the surgeon quite in doubt as to the method of treatment to employ.

A careful follow-up of end results in a fairly large series of such cases personally observed, has shown that in most of the cases classified as chondroma the disease continued to progress, showing more and more the characteristics of a malignant tumor, and finally caused death. In the later stages of the disease, if sections of the tumor were examined, the diagnosis would usually be changed to that of chondrosarcoma. Therefore, I have learned to give less and less heed to the microscopic diagnosis of chondroma in a case of tumor of the long bones in which the clinical history of fairly rapid development, and other features, including the roentgenogram, point rather to an osteogenic sarcoma. In a typical, benign chondrosarcoma, the roentgenogram alone is often so characteristic that a diagnosis can be made.

Myxoma. Myxoma is a very rare tumor of the bone; and we are indebted to Dr. Bloodgood more than to any other surgeon for our knowledge of this condition. It is difficult to distinguish it from that of osteitis fibrosa cystica or giant-cell tumor or chondroma. Exploratory operation is the only method by which a positive diagnosis can be made.

While the most important part in the diagnosis of malignant tumors is to differentiate them from other and benign or inflammatory conditions, we should be able to distinguish the different types of sarcoma, at least the more important types, from one another. This is essential because there is no general plan of treatment for all types of sarcoma of the long bones, the methods of treatment employed in the different types varying widely.

This is especially true of the osteogenic type distinguished from the round-cell (classified by Dr. Ewing as endothelioma or endothelial myeloma). For the former, I believe that early amputation followed by toxin treatment should be the method of choice, while in the latter, the tumor is so sensitive to both radiation and toxins that there is a reasonable hope of saving the limb by conservative treatment, and amputation may be postponed without undue risk to the life of the patient. Again it is important to be able to distinguish between the benign giant-cell type and the malignant central, since the treatment of the two conditions is entirely different.

Endothelioma or endothelial myeloma type. This group of tumors which is now very generally designated as Ewing's tumor, because Ewing was the first one to give an accurate histologic and clinical description of it, forms a considerable percentage of the total number of malignant bone sarcomas. In the first thousand cases (including giant-cell tumors), of the Bone Sarcoma Registry, there were sixty-four cases that were placed in the endothelioma group; and in my own series of 170 cases of malignant, operable sarcoma of the long bones (not including giant-cell tumors), there were twenty-six cases of endothelioma, or fifteen per cent. of the total number.

The clinical features of a typical case are somewhat as follows: The trouble usually originates in the shaft of a long bone instead of in the neighborhood of one of the ends of the bone, which is usually the case in osteogenic sarcoma. There is a history of antecedent local trauma in about the same proportion of cases as in the ordinary type of sarcoma. The tumor is apt to involve a considerable portion of the bone, one-half to one-third of the shaft, at the time of first observation. While the trouble usually starts in the central portion of the bone, there are cases in which it apparently originates in the periosteum or subperiosteal tissue. It seldom destroys sufficient bone to cause a pathologic fracture, although pathologic fracture has been observed in several of our own cases. It shows little or no tendency to produce new bone, and in these cases one never sees the marked new bone production with typical lines radiating at right angles to the shaft of the bone. It has more of a tendency to produce separate layers of tumor tissue laid down parallel to the shaft of the bone. In our own series of cases, the tumors have not as a rule proved to be so highly vascular as has been found by Howard and Crile. One of our most recent cases was highly vascular. In contradistinction to the ordinary osteogenic sarcoma these tumors show marked susceptibility to the influence of roentgen rays, radium, and toxins, often disappearing entirely after a few weeks' treatment; unfortunately, however, the disease is apt to recur within a few months either locally or in the form of metastases to the lungs or other bones. This type of tumor shows a special predilection to invade other bones, especially the skull.

The pathological diagnosis of this tumor has been so fully described by Ewing, especially in his "Review and Classification of Bone Sarcomas"[19], that it will be unnecessary to dwell upon it in the present paper. A

further description of the clinical features of this type of tumor and the treatment and prognosis may be found in an earlier paper already referred to[20].

This type of tumor furnishes some additional evidence in favor of the theory that malignant tumors, or at least a certain number of them, are due to some infectious cause or micro-organism. Here we have a tumor that so closely resembles osteomyelitis, or a known infectious disease, that clinical, roentgenologic, biopsical, and even microscopic examination of the tumor tissue removed, all point to a definite diagnosis of osteomyelitis; and yet, the subsequent history shows it to be a malignant tumor. If osteomyelitis is caused by a known micro-organism, is it not possible to assume that some other type of unknown micro-organism closely resembling the former, may give rise to an endothelioma type of neoplasm which so strikingly simulates osteomyelitis?

Giant-cell sarcoma. This type of tumor was recognized by Paget[21] as differing from the ordinary bone sarcoma in the matter of malignancy; but it was Nélaton[22], who, in the lengthy monograph that has become classic, first gave a very complete and accurate clinical and histologic picture of what he characterized as *tumeurs à myeloplaxes* or giant-cell tumor. The principal clinical and macroscopic characteristics of this tumor are as follows:

1. Location: in the ends of the long bones usually starting in the epiphysis or the extreme end of the diaphysis and seldom involving the joint.

2. There is a tendency to being self limited or encapsulated, showing no inclination to infiltrate the soft tissue even in the rare cases when the bony shell has been destroyed.

3. On section they are very vascular, and usually have a characteristic color,—*i.e.*, dark red or red mixed with gray, and are usually quite friable.

4. They grow more slowly than do the periosteal or malignant central tumors.

5. Unless completely removed they may recur locally, but seldom metastasize. Nélaton and many later authorities, especially Bloodgood[23], believe that these tumors never metastasize.

It is very generally believed that it is possible to make a correct diagnosis of giant-cell sarcoma from the clinical and roentgenologic evidence alone, but our experience at the Memorial Hospital and the Hospital for Ruptured and Crippled has proved that if we rely on such evidence alone, we shall find ourselves in error in about one out of every five cases, or, in twenty per cent. Inasmuch as such an error may result in the loss of life of the patient, I cannot believe that we are justified in taking such a risk, if there is any safe way by which we can make a correct diagnosis before treatment is begun. While it has now been proven that giant-cell tumors of the bone can be cured by roentgen-ray or radium, by no means can all such cases be cured by radiation. My chief objection to radiation as the method of choice is that we are not certain that a given tumor is a benign

giant-cell tumor (There is a one-in-five chance that it may prove malignant.) and if we continue radiation indefinitely in such a case, metastases may develop before we have recognized our error. Hence, I believe the importance of making a correct diagnosis early in all cases of central tumor of the long bones justifies an exploratory operation, and far outweighs all the disadvantages associated with such exploration.

This exploration should not be a mere biopsy, and should be undertaken only by the surgeon who is to have future charge of the patient, and who has had sufficient experience with bone tumors to enable him to carry out the most careful surgical technique. In all cases of giant-cell tumor, the entire tumor should be curetted down to healthy bone, and the cavity swabbed out with zinc chloride. Therefore, the so called exploratory operation is not a biopsy but, to my mind, is the method of choice to be employed in the treatment of giant-cell tumors. In this opinion, Bloodgood and most surgeons, here and in Europe, I believe, concur.

If the microscopic examination shows that the tumor is of a definitely malignant, metastasizing type, then we can amputate, following this with prophylactic toxin treatment. Personally I always use the toxins after curettage for giant-cell sarcoma. However, as this paper is confined to *diagnosis*, the question of treatment will not be discussed. For a more complete description of giant-cell tumors, the reader is referred to my two previous papers on the subject[24, 25].

A brief résumé of our series of cases, diagnosed as benign giant-cell tumor from clinical and roentgen-ray evidence, which later proved to be malignant, follows:

S. Giant-cell tumor of lower end of femur; clinical and roentgenologic diagnosis apparently confirmed by incomplete biopsy; no curettage. Tumor increased in size under radiation to such an extent that there was complete disability. Amputation was performed because the leg was useless, although the condition was still believed to be one of benign giant-cell tumor. Microscopic diagnosis of amputated specimen was that of highly malignant sarcoma. Death resulted shortly after.

G. Benign giant-cell tumor of the upper end of the tibia treated for two years with roentgen-ray; slow increase in size of tumor, pathologic fracture, and useless limb. Amputation was performed. Microscopic diagnosis was that of probable malignant tumor; although the exact nature of it was never definitely determined. Prolonged toxin treatment was given as a prophylactic measure. Patient is well two years later.

In this case if an early amputation had been performed, the patient would have been spared two years of almost complete disability.

H. Tumor of the upper end of the femur, in the region of the trochanter. Clinical and roentgenologic evidence pointed almost positively to a benign giant-cell tumor. Radiation given for nearly a year. The tumor increased in size, the condition finally became inoperable, causing death from extension into the pelvis (no general metastases).

H. Tumor of the lower end of the tibia following a recent trauma. Roentgenogram typical of a benign giant-cell tumor. Treated for three months with radiation. The tumor rapidly increased in size, metastases developed and the patient died five months after the beginning of treatment.

T. Tumor of the lower end of the femur, apparently a typical benign giant-cell tumor. Treated for two and one-half years with radiation. Pathologic fracture occurred at the end of two years' treatment, resulting in a useless leg. Amputation was

performed, and Dr. Ewing's microscopic examination showed the tumor to be not a benign giant-cell sarcoma but a malignant central sarcoma. This is a recent case and the ultimate result is unknown.

U. Tumor of the ulna believed to be a giant-cell tumor. Treated for nearly two years with roentgen-ray. Slow increase in size of tumor. The patient finally developed metastasis in the jaw.

This case is interesting for the reason that it was selected from all the giant-cell tumors observed at the Memorial Hospital, and included by Dr. Kolodny in his admirable and exhaustive review of the Bone Sarcoma Registry data, as a typical examination of giant-cell tumor.

CASE 6. CENTRAL OSTEOGENIC SARCOMA OF LOWER END OF FEMUR SIMULATING CHRONIC OSTEITIS MICROSCOPICALLY, WHILE THE ROENTGENOGRAM SHOWED A TYPICAL GIANT-CELL TUMOR.

R. C., male, aged forty-eight years, a laborer by occupation, first noticed pain in the left knee in June, 1927. There was no history of injury. On August 13, 1927, two months later, he was admitted to the Hospital for Ruptured and Crippled. Physical examination at this time showed a slight swelling of the left knee. Full extension was painful, and impossible beyond 175 degrees; flexion was about normal. There was some tenderness and swelling over the inner aspect of the lower end of the left femur. The roentgenogram was very suggestive of a giant-cell sarcoma.

On August 22, 1927, the patient was operated upon by Dr. Armitage Whitman: A six-inch incision was made on the internal aspect of the knee joint. The condyle of the femur was exposed, the periosteum incised and stripped back. With mallet and gouge the internal condyle was opened and at a depth of about one-quarter of an inch, pinkish-gray gelatinous material was encountered. The opening was enlarged to a diameter of about one inch and a large curette was inserted. The entire lower extremity of the femur was found to be the site of a cavity occupying both condyles, running down apparently to the cartilage of the inner extremity and running upward in the shaft to a distance of about four inches. The cavity was lined with smooth grayish membrane. The contents were carefully evacuated and the walls scraped down to the underlying bone. The walls of the cavity were then swabbed with pure carbolic acid followed by alcohol. The wound was closed without drainage. A posterior splint was applied.

A microscopic examination was made by Dr. F. M. Jeffries, whose diagnosis was that of osteogenic sarcoma with extensive necrosis.

The exploratory wound healed by primary union. I first saw the patient in consultation with Dr. Whitman on August 30, 1927. In view of the microscopic report and the history of rapidly developing tumor, I advised an immediate amputation, to which the patient consented. He was accordingly transferred to my service. The microscopic sections and roentgenograms were submitted to Dr. Ewing, who, after examining them, stated that he believed the condition to be one of chronic osteitis without any definite evidence of malignant disease. In view of this opinion, I hesitated to perform an immediate amputation, and decided to try conservative treatment for three or four weeks. The patient was removed to the Memorial Hospital on September 2, 1927. A roentgen-ray examination was made by Dr. Herendeen on the day following, and his report reads as follows:

"There is a destructive process involving the condyles of the femur. There is a defect in the cortex anteriorly but this may be a result of the recent operation. No new bone formation. Chest is negative."

The toxin treatment was begun on September 3, 1927; the initial dose of one-half minim was increased gradually up to the point of producing a marked reaction, temperature of 103 degrees. Sixteen injections in all were given. In addition, the patient was treated with the radium pack which was applied at a distance of ten centimeters from the surface of the lower end of the femur. From September 3 to September 27, a total of 40,000 millicurie hours of radium was applied.

While roentgen-ray examination showed no definite changes to have taken place,

FIG. 9

Case 6, R. C. Highly malignant central tumor (clinically) with roentgenological features of typical giant-cell sarcoma, and with microscopical picture closely simulating chronic osteitis.

FIG. 10

Case 6, R. C. Three weeks later.

FIG. 11

Case 6, R. C. Same date.

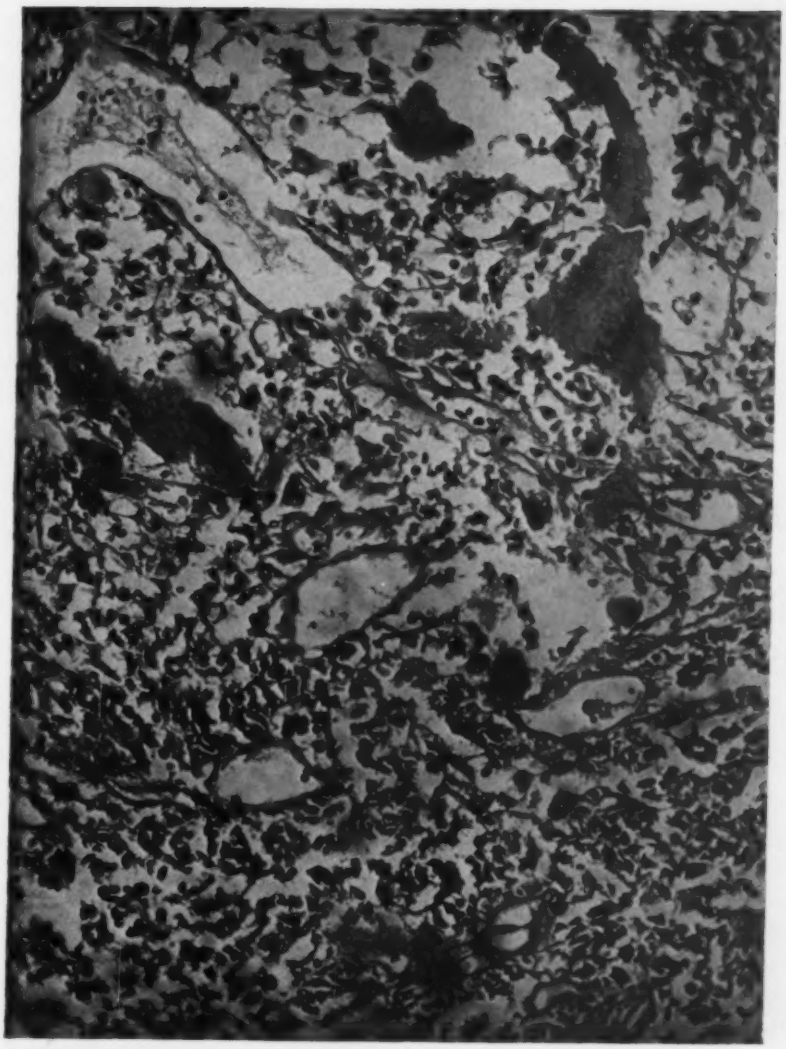

FIG. 12
Case 6, R. C. Photomicrograph.

the patient's symptoms were not at all relieved by treatment, in fact, the pain had increased in intensity. Finally, on September 28, 1927, I performed an amputation at the middle and upper third of the thigh. The specimen was submitted to Dr. Ewing, who reported as follows: "Chronic inflammation, minute fragment of necrotic tumor tissue, type undetermined".

No postoperative toxin treatment was given. The patient remained well until about the early part of February, 1928, when he complained of pain in the mid-scapular region. Roentgenologic examination failed to reveal any evidence of metastases. The pain became more severe and required morphine to control it. Two weeks later, palpation revealed a tumor in the mid-scapular region, between the scapula and vertebral

line. This had all the characteristics of a metastatic tumor of extrathoracic origin, probably starting in the periosteum of the ribs. The patient has continued to grow worse rapidly, and at present (May, 1928) is very weak and not expected to live but a few days.

FIG. 13

Case 7, L. T. Aug. 19, 1924. Clinical and roentgenological diagnosis: benign giant-cell tumor of femur. Treated for two and one-half years with radiation. Slow, steady progress of disease. Pathologic fracture; amputation. Microscopic diagnosis: malignant neoplasm.

FIG. 14

Case 7, L. T. Same case, March 26, 1927.

In my opinion, the history of rapid development accompanied by severe and persistent pain, in this case, justified the diagnosis of malignant bone tumor, in spite of the more or less doubtful microscopic pictures. The case has been registered in the Bone Sarcoma Registry (No. 873), where the following diagnosis was made: "Osteogenic sarcoma,—osteoid tumor present".

In this case then, we have a conflict of opinions among the pathologists as to whether the condition was one of osteitis or neoplasm. The roentgenogram was strikingly typical of giant-cell tumor. According to Dr. Armitage Whitman, the tissue found at the time of his exploratory operation, resembled more that of an inflammatory rather than a neoplastic condition; but he described the tissue as being greyish-white, more or less gelatinous, non-vascular, showing that it was probably not a giant-cell

tumor, unless it belonged to that rare type of so called white giant-cell tumor, described by Stewart of Leeds. The microscopic examination revealed no giant cells, but a structure which Dr. Jeffries and myself believed to be an osteogenic sarcoma with considerable degeneration. I urged an immediate amputation, to which the patient, as is rarely the case, quite willingly consented. However, before amputating, I submitted the microscopic sections to another pathologist of great experience in bone sarcoma, and he diagnosed the condition as one of chronic osteitis and not a neoplasm. In the face of this report, I was loathe to perform an amputation, and decided to give the patient a course of toxin treatment and radiation. The pain, which had been the most prominent feature of the disease, continued to grow worse in spite of treatment; the patient kept urging me to amputate, and, at the end of the third week, while the roentgenogram showed no evidence of progress of the condition, I did amputate. Photographs of this specimen show a very definite, clear-cut, endosteal tumor cavity occupying the lower end of the femur, the bony walls of which are still one-quarter of an inch thick; the joint is not involved. The cavity is filled with a smooth, glistening, greyish substance of the consistence of gelatine. Microscopic examination of this tissue and of the bone, showed no evidence of a malignant tumor; and I was criticised for having amputated a limb for a benign lesion.

The following two cases, to my mind, furnish further conclusive evidence that it is impossible to make a positive diagnosis of benign giant-cell sarcoma from clinical and roentgenologic evidence alone.

CASE 7. TUMOR OF LOWER END OF FEMUR. CLINICAL AND ROENTGENOLOGIC DIAGNOSIS: BENIGN GIANT-CELL TUMOR. TREATED FOR TWO AND ONE-HALF YEARS WITH ROENTGEN-RAY. SLOW INCREASE IN SIZE OF TUMOR; PATHOLOGIC FRACTURE. AMPUTATION PERFORMED. MICROSCOPIC DIAGNOSIS: VERY CELLULAR GIANT-CELL TUMOR; HAS MANY FEATURES OF TELANGIECTATIC OSTEOGENIC SARCOMA.

L. T., female, aged twenty-six years, first noticed pain and tenderness in the right knee, in June, 1924. Two months later, her leg suddenly gave way under her and she fell. The pain increased in intensity, and shortly afterwards she noticed a swelling. She was admitted to the Memorial Hospital on March 30, 1925, under the care of Dr. Craver. From May 21, 1925 to April 1, 1927, she received twelve exposures of roentgen-ray (twenty-five minutes each). Dr. Craver stated that in August, 1925, the patient probably had a pathologic fracture; she gave a history of having had a fall which was followed by severe pain and disability. The tumor at that time seemed no smaller; it was still partly cystic. A roentgenologic examination was made by Dr. Herendeen on September 3, 1925, and he reported that no evidence of any definite fracture could be seen in the films of the knee. On November 28, 1925, the patient was seen at the Staff Conference at the Memorial Hospital, and an amputation was advised. She stated that she wished to wait until after Christmas to have it performed; but by that time, she was able to straighten out her leg better, the pain had disappeared, the tumor seemed somewhat smaller, and it was decided to continue the roentgen-ray treatment. Examination on October 14, 1926 showed the tumor to be larger and also firmer. Owing to the pain following the last roentgen-ray cycle, the patient had remained away from the hospital for eight months. Roentgen-ray treatment was continued.

Roentgenologic examination by Dr. Herendeen, on October 14, 1926, showed: "Evidence of some increase in the size of tumor since the examination of eleven months

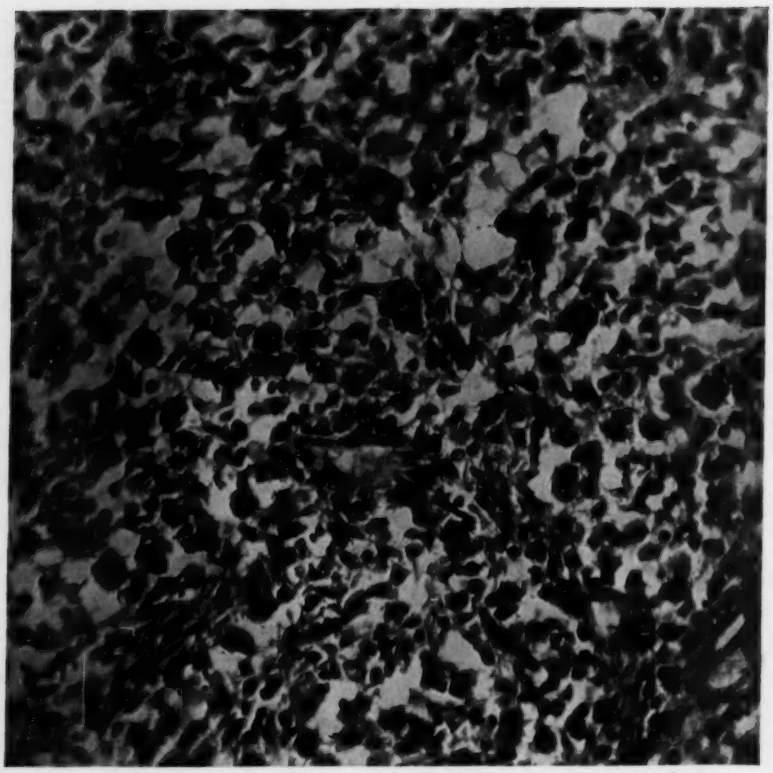

FIG. 15
Case 7, L. T. Photomicrograph.

ago, but there is some bone production under the periosteum and through the tumor area".

A follow-up note made on March 26, 1927, stated that the tumor was definitely smaller; that there were no symptoms and that there was less flexion of the knee. Examination on October 6, 1927, showed the tumor to be extending anteriorly and medially. On account of long continued disability, an amputation was advised, and performed by Dr. Bradley L. Coley on October 19, 1927.

Pathologic report by Dr. Ewing, October 19, 1927: "The lower end of femur is the seat of a tumor mass eight by eleven centimeters. The tumor is a multicystic mass, composed of several cysts, two centimeters wide, filled with blood fluid clotted and with brownish-yellow tumor tissue. Above it is sharply marked from the shaft, below it perforates the surface, causes partial ankylosis of knee, and penetrates upper surface of tibia one centimeter deep with a small tumor nodule in shaft of tibia. The patella is also excavated and occupied by a tumor mass two centimeters wide. The capsule of tumor is destroyed and the tumor tissue infiltrates derma at several points. This is a typical multicystic, giant-cell, brownish-yellow tumor, with unusually wide extensions.

"*Microscopic examination:* Very cellular giant-cell tumor; giant cells scanty; stroma cells abundant and atypical. Not typical epulis tumor; has many features of telangiectatic osteogenic sarcoma. No definite bone formation. Prognosis doubtful; look for pulmonary metastases."

A copy of the patient's history together with a complete set of roentgenograms and a microscopic section was sent to the Bone Sarcoma Registry. Dr. Crowell stated that the case had been given number 858, and had been classified as a benign giant-cell tumor.

CASE 8. BENIGN GIANT-CELL TUMOR OF LOWER END OF HUMERUS (CLINICAL AND ROENTGENOLOGIC DIAGNOSIS). TREATED WITH ROENTGEN-RAY FOR NEARLY THREE YEARS. CONDITION LATER PROVED TO BE THAT OF A MALIGNANT METASTASIZING TUMOR.

A. U., female, aged sixty-five years, first noticed "fever" and pain in the right shoulder and medial part of the arm in March, 1924. Four months later the symptoms localized in the right elbow. There was no definite history of injury except that she had had several hard falls during the previous three years. In July, 1924, the forearm began to swell and became very painful. The patient was referred to Dr. Ewing on October 20, 1924. She was admitted to the Memorial Hospital and placed under the care of Dr. Adair, whose report at that time, was as follows: "X-rays of elbow taken one week ago show a huge giant-cell tumor of humerus just above the joint (elbow) and so very lacking in osseous tissue as to be just ready to break. Plaster-of-Paris splint applied posteriorly for arm support."

The patient was put upon roentgen-ray treatment; from October 30, 1924 to August 17, 1927, she received eighteen exposures varying in duration from five to sixty minutes each.

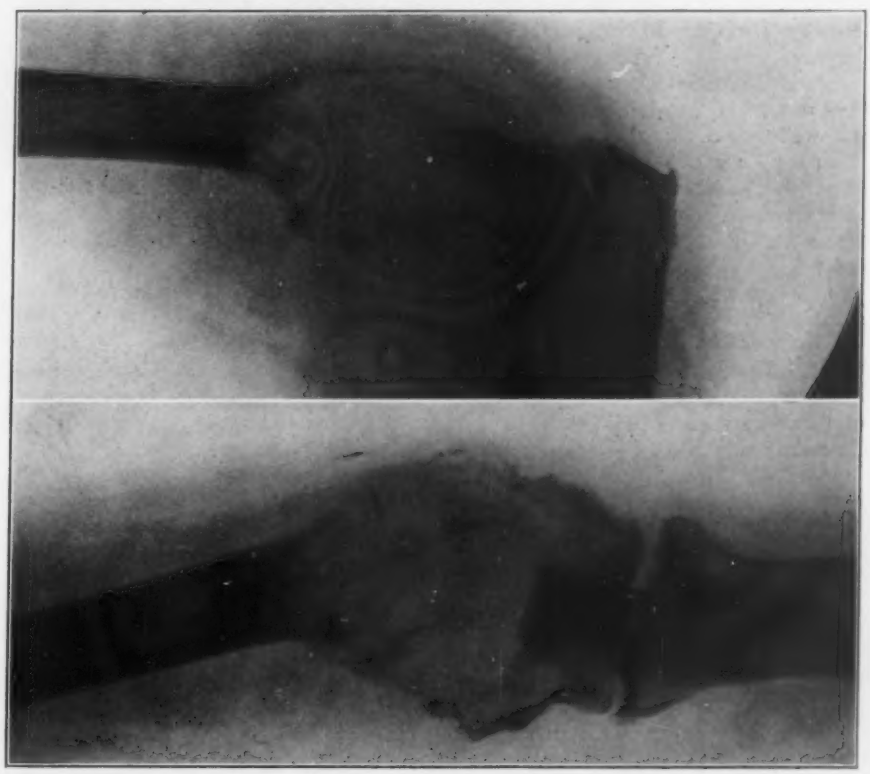

FIG. 16

Case 8, A. U. Clinical and roentgenological diagnosis: benign giant-cell tumor of humerus. Treated for two years with roentgen-ray. Slow progress of disease. Metastasis to lower jaw two and one-half years later, showing condition to be a malignant process.

Follow-up Notes:

March 3, 1925: The arm is still in posterior splint. The excruciating pain has largely disappeared.

September 14, 1925: The arm is slightly smaller and less painful.

October 22, 1925: Roentgenogram taken by Dr. Herendeen shows some increase in ossification, when film made today is compared with previous film.

January 6, 1926: Roentgenogram shows evidence of considerable bone destruction.

September 16, 1926: Roentgenogram shows continued thickening of peripheral bone.

December 29, 1926: Roentgenogram shows no evidence of salivary calculus, but the appearance of the ascending ramus of the mandible suggests destruction.

February 9, 1927: Lateral view of the sternum reveals evidence of some irregularity of the external surface of the lower part of the gladiolus. No definite evidence of pulmonary metastases.

April 23, 1927: Roentgenogram shows large defect in ascending ramus. There is some broadening of the superior mediastinum. No other abnormality in the chest. The pelvic bones are negative. There is slight decrease in height of left side of fifth lumbar vertebra.

August 17, 1927: Examination by Dr. Blake shows tumor of occipital region to be very small; jaw appears normal. The patient is feeling fair; she complains of no pain; has a little cough. She is to have a low-voltage treatment over the tumor of the occiput.

May, 1928: Patient is still under treatment.

This case (No. 791) has been diagnosed by the committee of the Bone Sarcoma Registry (Drs. Crowell, Phemister, Codman, Simmons and Ewing) as a benign giant-cell tumor.

It is of added interest from the fact that it was selected by Kolodny from a very large number of cases treated at the Memorial Hospital as a typical example of a benign giant-cell tumor.

Later Note: The patient was shown at the Memorial Hospital Staff Conference in May, 1928, at which time she was in good general condition. She had fair use of her arm; there was marked limitation of motion at the elbow. The jaw was apparently in normal condition. The tumors in the occipital bone and sternum were apparently under control.

Comment: In this case, two hypotheses are tenable: (1) that it was a primary malignant tumor of the humerus, of the endothelioma type, with multiple bone metastases; (2) that it was an example of the very rare condition of multiple benign giant-cell tumor. The fact that the condition proved susceptible to radiation favors the diagnosis of endothelioma type of bone sarcoma. Furthermore, multiple giant-cell sarcomas are so extremely rare that Dr. Codman has recently stated that thus far not a single example has been found in the Bone Sarcoma Registry collection.*

DIFFERENTIAL DIAGNOSIS BETWEEN SECONDARY AND PRIMARY MALIGNANT TUMORS OF THE BONES

This is a subject upon which little has been written; and until recently our knowledge of secondary bone tumors has been very limited. The frequency of metastases occurring in cases of bone tumor is just beginning to be recognized. Putti and Camurati of Bologna[26], are the only writers that I know of who have made a complete study of all tumors of the bone that have been observed at a large orthopaedic hospital for a long period of years (thirty). This study embraces both primary tumors (benign seventy-four and malignant eighty-five), and secondary tumors of bone (thirty-one).

*I am indebted to Dr. Frank Adair and Dr. R. Herendeen for the privilege of reporting this case.

It was surprising to me to find the number of secondary tumors so large. Nové-Josserand and Tavernier, in their monograph so frequently cited, emphasize this large number of metastases occurring in bones.

Waring[27] in his excellent monograph on "The Surgical Treatment of Malignant Disease" quotes Joll's[28] account of 1144 autopsies for malignant disease, in which bone metastases were found in fifty-three cases. The bone involved in these fifty-three cases was as follows:

	Cases	*Per Cent.*
Vertebrae	19	21.6
Ribs	18	20.6
Sternum	13	14.7
Femur	13	14.7
Skull	9	10.2
Humerus	7	7.9
Pelvis	4	4.5
Tibia	2	2.2
Mandible	1	1.1
Scapula	1	1.0
Clavicle	1	1.1

Secondary tumors of the bone may develop from a primary sarcoma of the bone. The type that most frequently metastasizes in bone is the so called endothelioma or Ewing's tumor; although, the ordinary osteogenic sarcoma may occasionally metastasize in bone. A secondary tumor of the bone may develop from a neoplasm primary in the soft parts near the bone. Such cases are rare, and seldom cause much difficulty in diagnosis. Nové-Josserand and Tavernier report a case of parosteal fibrosarcoma which, at first operation, was quite movable and not attached to the tibia, but after two operations, the tumor recurred and finally became firmly adherent to the bone. The roentgenogram showed no definite bone involvement beyond a slight thickening of the cortex and irregularity in the periosteum. This tumor showed little tendency to penetrate into the bone itself. Epithelial tumors have a much greater tendency to invade the adjacent bone; this is seen in rodent ulcer of the forehead, in carcinoma of the tongue and mucous membrane of the jaw, and in tumors of the maxillary sinuses. The process of involvement causes at first a destruction of the neighboring bone, and then, absorption of the destroyed bone with replacement first by connective tissue and later by neoplastic cells. When we speak of secondary tumors of the bone we usually mean the far more numerous group of metastatic carcinomas or hypernephromas which develop by generalization.

It is the diagnosis of these tumors that is often most difficult, and in some cases impossible, without waiting for the clinical end result to establish it beyond question. The main difficulty arises from the fact that in a very considerable number of such cases the primary tumor is latent and has given no clinical evidence of its existence. This fact shows that it is necessary in all cases of suspected secondary bone tumor, and, in fact, in all bone tumors, to make a most careful general physical examination.

In addition, it is important to get a very careful history that will disclose whether or not the patient has ever had any tumor removed from some other part of the body, at some previous time. If the patient is a female, the breast and uterus should be examined; and if any operation has been performed, one should endeavor to get the pathologist's report of the tissue removed. I have observed many cases in which I have been called upon to treat a supposedly primary sarcoma of the femur or spine, in which no history of trouble elsewhere had been elicited, and yet careful physical examination revealed a small carcinoma of the breast or a primary carcinoma of the prostate that had not been discovered for the reason that no careful examination had been made. I recall one case, a middle-aged woman with very extreme hypertrophic changes involving the entire skull, which had been regarded as possible Paget's disease; but careful examination revealed a small, hard lump in the breast, which proved to be a carcinoma; this had developed bony metastases in the skull. The thyroid gland should always be examined and the patient carefully questioned as to whether any tumor had ever been removed from any part of the body.

Gross[29] in 423 acute cases of cancer of the breast found metastases in the bone in twenty per cent. In a series of 533 cases of breast cancer, McWilliams[30] found that thirty-six had developed metastasis in the skull, twelve in vertebrae, eight in the femur, and eight in the humerus. In 1985 cases of breast carcinoma observed at the Mayo Clinic, Meyerding[31] found sixty-seven cases of bone metastases or three and forty-eight one-hundredths per cent. It is interesting to note that the bone metastases that develop in breast cancer are confined chiefly to the slowly growing, scirrhous type, and may develop many years after the tumor is first noticed, or five or ten years after operation. Secondary carcinoma is very often observed in cancer of the prostate; Kauffman[32] believes that it occurs in seventy per cent. of the cases. Hypernephroma also is a type of tumor most prone to metastasize in bone; and it has been estimated that twenty per cent. of all cases of hypernephroma develop bone metastases. The metastases from hypernephroma furnish the greatest difficulty of all in early diagnosis for the reason that the primary tumor cannot be detected and may give no symptoms for a long time. Of seventy-six cases of hypernephroma of adrenal origin, observed by Stevens[33], eleven showed metastases in the skull and three in the ribs. The diagnosis of these cases is usually not difficult, as a fairly characteristic histologic picture is present.

Nové-Josserand and Tavernier[34] state that in 1909 they reported a case in which they had performed an amputation for a tumor of the upper end of the tibia, which proved to be an epithelial tumor, with *globes comès*, and yet a minute physical examination failed to reveal any trace of a primary tumor elsewhere. Two years later they again operated, removing some enlarged glands in the groin, which showed the same histologic structure. They were still unable to find a primary tumor. The case was lost sight of after the second operation, and the end result is unknown. I have observed several cases in which most expert pathologists have pronounced the tumor to be an

epithelioma secondary to some primary tumor elsewhere. To illustrate, the following case is cited:

CASE 9. PRIMARY SARCOMA OF HUMERUS OR SECONDARY CARCINOMA (?).

J. F., male, aged fifty-four years, first noticed discomfort and disability in the left humerus in 1923. There was no history of trauma. A roentgenogram was made and roentgen-ray treatment was begun. On June 3, 1924, he consulted Dr. Bloodgood, who, believing that the condition might be one of Paget's disease, explored the skull. He reported that the bone showed no evidence of metastasis nor of any tumor. Roentgen-ray treatment was carried out by Dr. Willis F. Manges of Philadelphia, who, in a later report (Jan. 14, 1925) to the family physician, Dr. E. T. Steadman of Jersey City, New Jersey, stated as follows:

"I regret that the condition in Mr. F.'s arm is gradually progressing—especially down along the outer half of the shaft of the left humerus. Strange to say, the inner half of the shaft of the humerus is not involved and never has been, and originally there was quite a definite tumor mass in the soft parts which went away under x-ray treatment and has never recurred. He had a spontaneous fracture some months ago but this has never united, so that it has been necessary for him to have some little support to the humerus and the arm has necessarily been out of commission.

"I have been trying to persuade myself that it was not advisable to do a surgical operation, because nothing short of amputation would be of help and we would probably not be able to control the lesion even with an amputation. In this, Dr. Bloodgood of Baltimore agreed with me."

In January, 1925, the patient consulted Dr. F. H. Albee of New York. The latter performed a biopsy. The specimen was examined by Dr. Paul Klemperer, Pathologist of the Post-Graduate Medical School and Hospital, who reported as follows:

"*Frozen Section Diagnosis:* Sarcoma of undetermined origin, apparently invading bone from the outside.

Gross: Specimen is a grayish-white, rather dense tissue.

Microscopic: Sections show tubular elements which are lined by large cuboidal cells with pale nuclei which each show a nucleolus. The cells show frequently mitotic figures. Occasionally, cells are found in small groups within the stroma which is composed of connective

FIG. 17

Case 9, J. F. Malignant tumor of humerus. Microscopical diagnosis (by Klemperer, confirmed by Ewing and Bloodgood): metastatic carcinoma. Clinical and roentgenological diagnosis: primary sarcoma of humerus, endothelioma type. Amputation followed by toxin treatment for six months. Patient well with no evidence of primary tumor, three years later.

tissue fibers. Within the stroma, there are numerous blood vessels and occasionally the epithelial cells show perithelial arrangement. Frequently the cell-body is vacuolized, particularly in one of the sections.

The histologic picture is that of an epithelial tumor. Therefore, the tumor must be considered as a metastasis.

The histological structure strongly suggests primary tumor of the kidney.

Diagnosis: Metastasis of an epithelial tumor, possibly kidney."

These sections were submitted to Dr. Bloodgood also, who confirmed the diagnosis.

The patient was referred to me by Dr. Albee on April 1, 1925. Physical examination at this time showed irregular, diffuse enlargement of the whole central part of the left humerus extending to within two inches of the upper end and down nearly to the

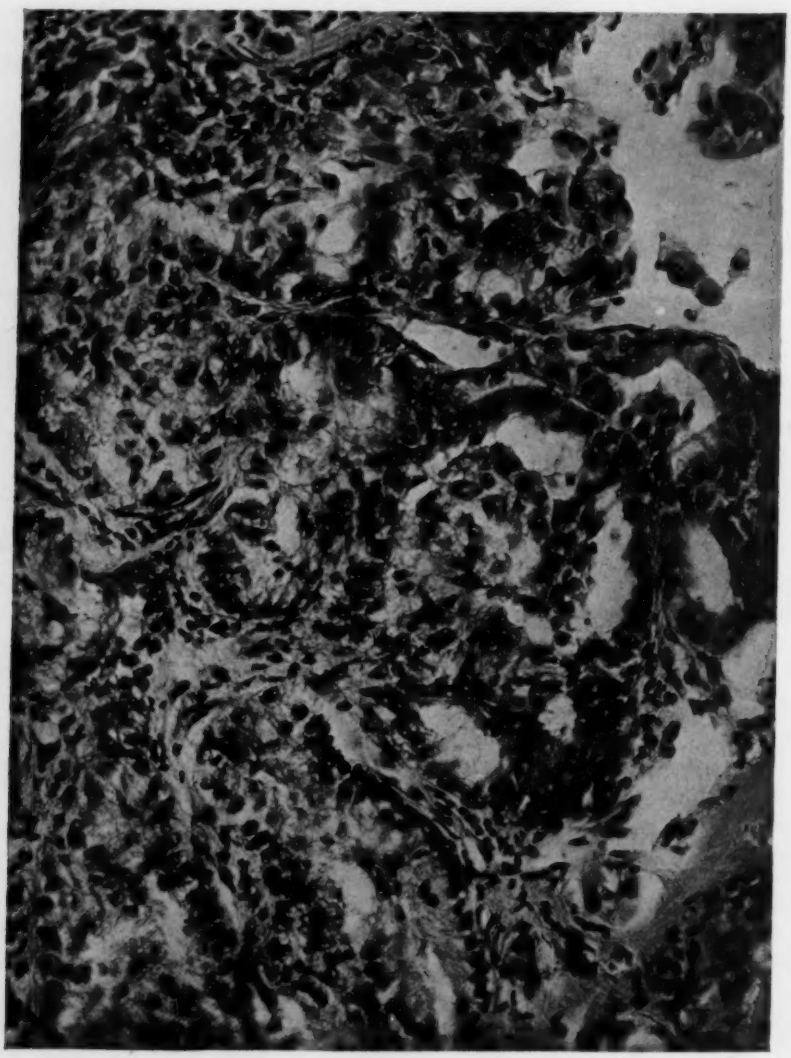

FIG. 18
Case 9, J. F. Photomicrograph.

elbow joint. From the clinical appearances I was inclined to regard the condition as a primary tumor rather than a secondary carcinoma or hypernephroma. No evidence of metastases nor of a primary tumor elsewhere could be detected. There was no enlargement of the kidneys nor of the abdominal glands. The prostate was normal.

In view of my belief that the tumor of the humerus was a primary one, and furthermore, because of the fact that the arm was entirely useless and a source of great discomfort, I advised an immediate amputation. The patient was referred back to Dr. Albee, who soon after performed an amputation at the shoulder. The specimen was submitted to Dr. Klemperer who again made a diagnosis of metastatic epithelial tumor and not a primary sarcoma, which diagnosis was confirmed by Dr. Bloodgood and Dr. Ewing.

The patient then received prophylactic toxin treatment. Two or three injections a week were given for six months and then one injection a week for a considerable period thereafter. He was shown at a Staff Conference at the Memorial Hospital in February, 1928, at which time he was in excellent health; examination failed to reveal any evidence of a primary tumor elsewhere. The patient remains well at the present time, three years since he first came under my observation.

In this case the early clinical and roentgenologic diagnosis was most difficult. In the opinion of Dr. Bloodgood, it simulated Paget's disease. A piece of the skull was removed and examined for Paget's disease, with negative result. When I first saw the patient a biopsy had been performed, and a microscopic diagnosis of secondary epithelioma had been made by several pathologists, including Dr. Bloodgood and Dr. Klemperer of the Post-Graduate Hospital. Personally, from the clinical and x-ray evidence, I regarded the condition as a primary bone tumor of the humerus of an atypical endothelioma type. I advised amputation because the arm was useless and a source of great pain and discomfort. The specimen and roentgenograms were submitted to Dr. Ewing who, after a careful examination, confirmed the diagnosis of metastatic epithelial tumor. A careful physical examination failed to reveal any primary tumor elsewhere, nor has there been any evidence of such up to the present time, three years after the amputation. If the tumor was really a metastasizing epithelial tumor, as the pathologists agree it was, then we are forced to conclude either that the primary tumor has remained latent and undiscoverable for nearly five years, or, that it has been cured or kept latent and inactive by the long continued toxin treatment. Inasmuch as the epithelial type of tumor is much less favorably influenced by the toxins than is the sarcomatous type, it would seem difficult to believe that a primary epithelial tumor could have responded so well to the toxin treatment. It would seem to me more rational to accept the hypothesis that the tumor was a primary tumor of the humerus, of an atypical endothelioma type (which is very sensitive to toxins) and that amputation followed by prophylactic toxin treatment has resulted in, if not a cure of the disease, at least freedom from recurrence for more than three years. This is my own interpretation of this most difficult case for diagnosis.

Paget's disease. Paget's disease confined to a single bone occurs in very rare instances, and several cases have been reported during recent years. I do not believe it is possible in many cases to make a diagnosis

between sarcoma of the shaft of the bone and Paget's disease except by biopsy and microscopic examination. One of the most difficult cases to diagnose at the Memorial Hospital was the following:

CASE 10. CHONDROSARCOMA OF THE TIBIA SIMULATING PAGET'S DISEASE IN ITS EARLIER STAGES.

W. J. C., male, aged sixty-five years. The patient's family history was negative. In November, 1921, he had what was believed to be an influenza cold. He was confined to bed for about ten days, after which he was able to resume his work. In early December, 1921, he complained of pain around the right knee. Massage and hot applications were tried without relief. The pain became more intense, and violet-ray treatment was given for three weeks; this also brought no relief. The pain became somewhat lessened under sodium salycilate. About two months later, the patient noticed a swelling in the upper part of the right leg; in the middle of February, lameness developed, and in another couple of months, the right leg became flexed at the knee requiring the use of crutches.

Roentgen-ray examination by Dr. Max Kahn, on February 11, 1922: "The thickening and increased bone density of the head and cortex of the right tibia and the pubic and ischial bones is strongly suggestive of a low-grade chronic multiple osteomyelitis and periostitis."

FIG. 19

Case 10, W. J. C. Osteochondrosarcoma of tibia treated for eight months as a periosteitis or chronic osteitis. Condition in other skeletal bones suggestive of Paget's disease.

The patient was referred by Dr. Grier of Elizabeth, N. J., to Dr. Bloodgood of Baltimore. In the opinion of the latter, the patient had either a non-suppurating osteoperiostitis or Paget's disease. (He had had a full course of salvarsan; operation was not advised.) Dr. Bloodgood's report was negative except in regard to the tibial condition and the prostate gland. He stated that the latter was not enlarged; both lobes were of equal size, left being smooth, firm and elastic; and the right, smoother but with an area of induration which to the finger, felt definitely hard; there was no increase in the size of this lobe. The roentgenograms also were examined by Dr. Bloodgood, who reported as follows: "There is slight bowing of the upper half of the tibia, and on palpation this bone is long and it becomes larger at the middle third and gradually expands towards the knee joint, but it is not the bone shell of the central tumor but more the type we see in Paget's disease or any type of ossifying periostitis. About the bone, I cannot palpate any definite tumor. From external palpation it is confined to the bone only. The x-ray in the lateral view shows the early picture of Paget's or subperiosteal non-suppurating periostitis of the Garré type; I think we can exclude sarcoma. Wassermann: negative."

FIG. 20
Case 10, W. J. C. Photomicrograph.

The patient was admitted to the Memorial Hospital on May 2, 1922, at which time physical examination showed a diffuse, exquisitely tender swelling of the upper right leg apparently due chiefly to an enlargement of the upper half of the right tibia, especially of the head. There was little or no fluid in the knee joint. The circumference of the right leg, at the tubercle of the tibia, measured fourteen and five-eighths inches; that of the left leg, eleven and one-eighth inches. The right knee was flexed to a right angle, and in the popliteal space there was a brawny induration. There was considerable oedema of the right ankle and foot, and some tenderness about the right ischium. Roentgen-ray examination made by Dr. Herendeen showed "some lime salt deposit in the soft parts behind the head of the tibia". In his report of August 11, 1922, Dr.

FIG. 21

H. G. Osteitis fibrosa cystica simulating giant-cell sarcoma. Recovery under Whitman abduction treatment. Patient well over two years.

Herendeen stated that there was no change noticed in the present plates of the leg when compared with previous plates.

Over a period of one and one-half months, or, from May 4, 1922 to June 19, 1922, four exposures of roentgen-ray were given at the Memorial Hospital. The pain was not relieved by this treatment nor was the progress of the tumor checked. The patient was readmitted to the Memorial on August 15, 1922, when he was seen in consultation by Dr. William A. Downes. A diagnosis of periosteal sarcoma was made, and an immediate amputation advised. On August 18, 1922, an amputation was performed at the Elizabeth General Hospital. He made a satisfactory recovery from the operation, but his general health began to deteriorate rapidly. On September 1, he developed paraplegia with severe scrotal pains. Radium treatment was given over the spine but without benefit, and he died on September 15, 1922. There was no autopsy.

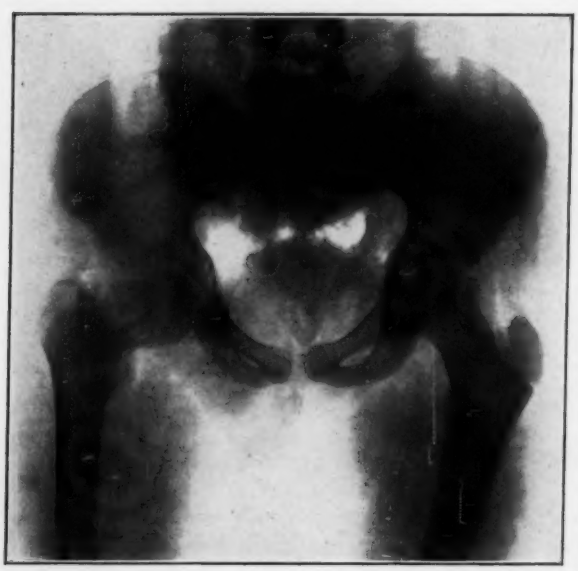

FIG. 22

H. G. Same case two weeks later.

A specimen of the amputated leg was sent to the Memorial Hospital laboratory where it was carefully examined by Dr. Ewing. He reported as follows: "The disease involved the upper eight inches of the tibia. A main tumor mass, four by four inches, arises from the posterior surface of the tibia and forms a rounded, well circumscribed, hard, glistening, cartilaginous tumor. The central portions are softened fluid excavated, but several segments are still solid. Several outlying hard cartilaginous nodules, size of marbles, lie among the tendons about the knee joint and some of these lie about the level of the joint. The joint surfaces are smooth, uninvolved, but covered

with blood and some fibrin. The marrow cavity of the upper four inches of the tibia is replaced by a solid sclerosing, partly calcified, partly cartilaginous, tumor tissue which is fused with the shaft anteriorly. The periosteum along the whole anterior border of the involved area is eroded. The thickening of the anterior portion of the shaft extends much farther down the shaft than on the posterior surface.

"*Microscopic:* Sections show a cellular chondroma, or chondrosarcoma, with very many foci of calcified deposits in the form of large loose granules. This calcification suggests x-ray effects.

Diagnosis: Chondrosarcoma."

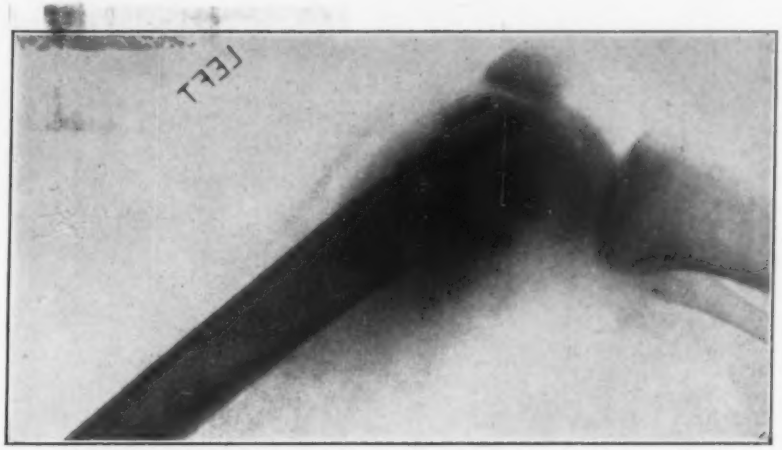

FIG. 23

L. F. Typical periosteal osteogenic sarcoma.

This case, in my opinion, illustrates the wisdom of an early exploratory operation whenever a positive diagnosis cannot be made from the clinical and roentgenologic evidence. Had a correct diagnosis been made eight months earlier, and an immediate amputation performed, I believe that the chances of saving the life of the patient might have been distinctly better. Roentgenograms of other bones pointed strongly to a diagnosis of Paget's disease, and it is possible that the sarcoma originated at the site of a preexisting Paget's disease of the tibia.

I have already given the main points in the diagnosis of the different types of sarcoma, but it might be well to summarize them, as follows:

1. The benign giant-cell tumor, or sarcoma as I still prefer to call it, is located in the region of the epiphysis, and is of slow development. The expansion of the bone, with a thin shell of cortex remaining, absence of dilated veins, destruction of bone without reproduction of new bone, history of antecedent trauma in fifty per cent. of the cases, all point to a diagnosis of giant-cell tumor.

2. A history of pain, persistent, increasing, following some days or weeks or months after a local injury, worse at night and not influenced by immobilization of limb; a swelling developing soon after the pain, located

FIG. 24

L. F. Cut section of same case.

in the diaphysis of a long bone but usually near an extremity, preferably the lower end of the femur or upper end of the tibia or lower end of the radius, firm in consistence but not of bony hardness, apparently springing from the bone itself and not movable; absence of temperature in the early stages and with but slight local heat; a roentgenogram that shows an irregular periosteal line, a stripping of periosteum and more or less new bone formation—all point strongly to a diagnosis of periosteal osteogenic sarcoma.

3. A tumor of the shaft of a long bone, occupying a large extent of the shaft, completely surrounding the bone, apparently involving both periosteal and cancellous portions, with little or no new bone production, the structure of the tumor often showing a laminated appearance, sometimes, especially if far advanced, associated with a pathologic fracture—such tumor if of fairly rapid development should point to a diagnosis of endothelioma or endothelial myeloma.

While this paper is limited to a discussion of the *diagnosis* of sarcoma of the long bones, I thought it might be of interest to the Association if I took advantage of the opportunity and showed the end result in a case of primary periosteal sarcoma of the femur, endothelioma type, with multiple metastases, that was treated by toxins and radium. The history of this patient whom I am presenting is as follows:

W. L. B., male, aged six years, when about three years old (1916) fell from a pony. A tumor developed in the upper third of the shaft of the femur, and grew rapidly. An amputation was performed by Dr. Stuart McGuire of Richmond, Virginia, in August, 1917; and a microscopic diagnosis of periosteal sarcoma of the round-cell type with no giant cells, was made.

In October, 1918, there was first noticed a swelling in the right parietal bone, and beginning exophthalmos; this was associated with a softened area of the skull, which steadily increased in size. The patient was referred to me in June, 1919, at which time examination revealed a depressed area occupying nearly the whole right parietal region with apparent absence of bone over this area (5 by 7.6 cm. in size); pulsation was easily felt; there was marked exophthalmos. Roentgen-ray examination by Dr. D. Quick showed destruction of both tables of the skull over the mid-parietal region, and an extensive intracranial tumefaction beneath, which strongly suggested a cyst. A hopeless prognosis was given, but a trial of toxin treatment was advised as a palliative measure. The injections were begun on June 6, 1919, the doses ranging from one-fourth to three minims; marked reactions were obtained. In addition, the patient received two radium-pack (lead tray) treatments over the right temporal and frontal regions (a total of 12,847 mc. hours, at 3 cm. distance). The toxin treatment was resumed at home. On readmission to the Memorial Hospital on August 6, 1919, it was found that the exophthalmos had nearly disappeared, and the tumor mass in the brain was barely palpable. Two radium-pack (lead tray) treatments were given over two areas of the right temporal region (total of 5,867.2 mc. hours at 30 mm. distance). On October 2, another radium pack was applied over the right temporal region (2,940 mc. hours), and on March 2, 1920, the lead tray was applied over two areas, the right parietal and the supra-orbital regions (2,992 mc. hours each). Roentgen-ray examination at this time failed to reveal any tumor; the bulging of the eye was slight. The patient's general condition was excellent. In the latter part of April, 1920, he developed a similar tumor with marked bone destruction in the occipital region (2.5 by 5 cm. in diameter) and easily shown by the roentgen ray. According to Dr. Herendeen, roentgenograms of the skull revealed evidence indicating further bone formation in areas previously involved in the destructive process. From July 8, 1920 until August 9, 1921, the patient received further radium treatment in the form of a lead tray over the parietal, occipital and temporal regions (total of 24,477 mc. hours at 3 cm. distance).

Physical examination on April 27, 1922, showed the patient to be in excellent general condition; there was only slight exophthalmos of the right eye; the sight was normal; the large area in the right parietal region which was originally almost completely destroyed, was almost entirely filled in with new bone; the occipital region also was normal. He had been attending school all winter and had made two grades. He was given another radium treatment at this time, more as a prophylactic measure than anything else. The toxins had been kept up with occasional intervals of rest, since the time of my first observation. The improvement was continuous, the patient gained in weight, and at the present time, May, 1928, there is no evidence of any return of the old trouble (nine years since the treatment was begun).

Dr. Ewing reviewed a microscopic section of this tumor, and was inclined to regard it as an endothelioma or endothelial myeloma. The diagnosis of the Bone Sarcoma Registry Committee (see case No. 348) was that of Ewing's tumor.

I cannot close without paying tribute to the Bone Sarcoma Registry

of the American College of Surgeons, or without expressing my admiration for its founder, Dr. Ernest A. Codman, whose patience and perseverance and unremitting labor covering many years made this Registry possible. With its great and steadily increasing wealth of material it will always be a Mecca for students and practitioners interested in bone sarcoma, and will be of great help in throwing more light upon the still difficult problem—the diagnosis of bone tumors. It must be remembered, however, that skill in the diagnosis of bone tumors cannot be acquired from a study of roentgenograms and microscopic sections alone, but in addition the student or surgeon must actually see many patients and be given an opportunity to study the clinical features and the gross pathology of the disease before he can feel reasonably certain of his ability to make an early diagnosis.

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Note: The discussion which followed the presentation of this paper will be published in a later issue of the *Journal* with the paper of Dr. Joseph C. Bloodgood which was discussed with it.—*Editor.*

OSSIFYING HEMATOMA*

BY SYDNEY M. CONE, M.D., F.A.C.S., BALTIMORE

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I am glad of this opportunity to present a case which illustrates one of the great factors in the pathology of bone, — namely, the circulatory system. I have described the changes occurring in bones due to alternating active and passive hyperaemia in Paget's osteitis deformans and in arteriosclerotic extremities. In writing of the activity of the bone cell, I stress the effect on bone, of oedema, of passive congestion and the physical action of a modified circulation as well as the added pabulum of extravasated blood. I have noted the activity of bone formation in the congested areas about acute and chronic inflammation. New bone formation was demonstrated in outpoured blood near centers of tubercular osteomyelitis, at hemorrhage about bone spicules transplanted into muscle, and in congested areas with outpouring of blood about tumor metastases and in tumors. I see it in the hemorrhagic exudate in gonorrhoeal exostoses.

I have numerous specimens demonstrating the activity of marrow cells and bone cells in passive hyperaemia, hemorrhage and thrombosis, of old cardiovascular cases. New bone and connective tissue form in many of these old ribs. The causes of this progressive tissue formation have as a rule been attributed to infection, but modified pressure and the additional nutrition of extravasated blood after the oedema has liberated the bone cell in the softened bone matrix, must be considered of prime importance in many cases of productive bone lesions. Osteitis fibrosa and osteitis deformans, local and general, must be considered among these. They have both been placed among inflammatory conditions with doubt. Some have used the term "low grade inflammation". One can more readily assume that the altered circulation along with its productive tissue formation was the real factor involved.

The clubbed fingers of Marie's osteopulmonary arthropathie hypertrophiante are probably due to such a circulatory imbalance. We see it in connective tissue hyperplasia where passive hyperaemia has existed a long time, intermittently, in the liver and other organs. MacCallum in his Text Book of Pathology says: "Repair must not be confused with inflammation nor regarded as a part of it. Since injury often excites inflammatory reaction, inflammation and repair may become inextricably entangled so that there has long been confusion with regard to 'inflammatory new growth'. Regeneration and repair sometimes take place with no

*Read before the American Orthopaedic Association at Washington, May 1928.

visible signs of inflammation. The two seem distinct in their causes, in their aims, and in the cells which participate. Wandering cells are concerned with inflammation and fixed tissue cells with repair. Intermittent pressure tends to cause excessive growth."

We must not forget that there are many factors other than bacteria producing pathological effects. Any of the elements acting as physiological stimulants to a cell (heat, pressure, chemistry, electricity) may, in excess, or when long continued, produce pathological conditions. It is a microscopic cell that is affected by these changes. It takes very minute alterations in the cell's habitat to alter its life. We seldom have one of these factors alone involved in the production of pathological bone (or other tissues), any more than we see only one element concerned in the normal growth of bone, muscle, liver, etc. The normal tissues grow differently at different ages. One finds a corresponding difference in one or another of the physiological aids to growth at different times. The circulation is not expected to continually keep up a constant, even pressure.

The capillary walls are not always of the even permeability of normal childhood. The chemistry (endocrine) of pituitary, suprarenal, ovaries, testicles, etc. varies in amount or character. There is a natural wasting or addition to tissues which decreases, or adds to, the pressure to which they are adapted. Even a normal heart changes in vigor as life proceeds. Many pathological conditions in tissues and organs have occurred all through life. These must be considered in estimating the changes in other tissues and organs. I see these effects (especially those of a cardiovascular pathology) in bone, just as one sees parallel changes in skin, muscle, fat, liver, spleen, etc. We use the terms neurotrophic atrophy, fibrosis, or senile atrophy. There is a circulatory, endocrine and mechanical alteration behind it all. Bone demonstrates it most clearly. We can understand it best in studying it more narrowly in a local pathological condition.

That physical agents, even though minute, may act as irritants, stimulating or depressing, is evidenced by the grooving of bone by vessels, the shaping of the skull by the brain, the jaws and pelvis by their contents. Aneurysms groove and penetrate bone. Pressure, even of soft parts, modifies bone growth (Todd, Ziegler, Konjetzny, MacEwen). With the change in circulation, we get not only modified mechanical effects, but there is often therewith oedema, thrombosis and hemorrhage with their accompanying pathology. Oedema dissolves bone salts, softens the matrix, and releases the bone cell. Hemorrhage adds to this increased pabulum and fibrin. This in the nature of a coagulation necrosis attracts lime salts. Bone results;—I have seen it in the calcification and ossification of caseous glands, hyaline connective tissues, in old corpora lutea of ovaries, fibromyomata, arteriosclerotic blood vessels, thyroid, kidneys. It has been produced experimentally in the kidneys (Pearce, Asami, and Dock—Lick, Sacerdotti and Frattin and Harvey). Bier assisted poor callus to active production by blood injections. Pochhammer attempting to produce bone in muscle by injecting irritants (agar and gelatin), was unsuccessful

until he used blood. Fischer was able to grow cartilage in vitro, using plasma from chickens and juice from chick embryos.

Buerger and Oppenheimer ascribe the bone formation in arteries to the thrombus formation.

Lehman demonstrated bone formation in hemorrhage at joints. Meyerding, Konjetzny, Looser, Mandl, Ponmer and Beneke demonstrate bone and cyst formation in old hemorrhages in bone. Konjetzny's and Meyerding's photographs are like some of the pictures of the case presented below. Giant-cell tumor of bone likewise exhibits photographs like mine.

The cases of osteitis fibrosa in my collection like those described by Sisk, Konjetzny, Mandl, and Looser exhibit the same pathology as the ossifying hematoma described, differing only in the location of and the amount of bone involvement. I would ascribe the condition to hemorrhage, passive congestion, and oedema, with their influence on the physics and chemistry of the surrounding bone. The giant cells are natural bone phagocytes for removal of degenerated bone and blood. The masses of round, oval, cuboidal and spindle cells are embryonal tissue cells or freed bone cells which are potential bone or connective tissue producers. Any or all of these cells may be found more or less permanent in unusual numbers, depending on the return of a normal circulation or the persistence of the imprisoned condition. They occasionally remain embryonal, grow excessively, and form sarcomas.

Codman sees in the giant-cell tumor a repair process, following intraosseous hemorrhages due to rupture of nutrient vessels.

Hemorrhagic osteomyelitis, exhibiting the same kind of cellular pathology as the ossifying hematoma, is considered by many as a tumor. Barrie says, "It should be thought of as regenerating granulation tissue whose end effort is the restoration of areas destroyed by some injurious agent. There is usually a history of trauma. These tissues possess potentialities for neoplastic change because of their primitive structure."

The bone formation in the case reported below is due to the presence of bone-forming cells in a nidus of fibrin and red blood cells (a favorable pabulum). The cells could quite readily have come as "osteoblasts" from the impaired periosteum. It might as well have been a metaplastic modification of the organizing connective-tissue cells in a tissue with slow circulation containing calcium salts. Wells, White, Asami, Dock, Harvey, Lick, Moschowitz, Pearce, Sacerdotto and Frattin, Buerger and Oppenheimer have described such a metaplasia in less favorable locations.

CASE REPORT

The patient, white female, aged nineteen, was operated on March, 1926, for a growth at the upper third outer side of the left humerus. Duration of tumor two and one-half months.

History of trauma followed immediately by pain and swelling. There has been no pain for the last month. The mass has enlarged slowly. It is now six by ten centimeters in size, smooth, circumscribed and oval in shape. No infiltration of surroundings. No tenderness.

FIG. 1
Fibrous wall containing bone.

X-RAY NOTE by *Dr. H. J. Walton*:—

"The roentgen examination of the left shoulder shows a circumscribed tumor mass about the size of an orange, attached to the outer surface of the upper end of the shaft of the humerus about four inches below the head. Interspersed throughout the tumor are numerous areas of increased density, less than that of bone and greater than that of the surrounding tissue, giving the mass an indefinitely mottled appearance. As there is a faint cortical shadow, the tumor appears to be walled off from the surrounding tissue. There is a small area of absorption of the cortex of the humerus about the center of the tumor on the shaft, with a general thinning of the cortex under the entire tumor, which is probably secondary to pressure upon the bone.

"The examination of the chest shows a normal appearance of the lungs, heart and diaphragm, and there are no bony changes noted.

"In view of the history of trauma and rapid growth of the tumor, and in the absence of bone and periosteal changes characteristic of malignancy, my impression is that the patient has an ossifying subperiosteal hematoma.

"Another condition which should be considered, however, is a myxoma, but owing to the slower growth of these tumors, and absence of characteristic bone changes, I believe this condition can probably be eliminated.

"Impression: Ossifying subperiosteal hematoma."

OPERATION, March 1926—Removal of Growth: Operator's Note:—

"Large masses of bone removed in different stages of ossification. August 1927,—Complete Recovery.

"The specimen consists of masses of tissue of varying consistency and color from a growth at the surgical neck of the humerus. There is an ensheathing wall two millimeters thick, firm in consistency and grey in color mottled with brown lines and dots (vessels). Bone masses are immediately beneath and partly incorporated in this outer fibrous tissue. Within this are areas of varying density and color. Sharply outlined cysts and irregular spaces, filled with brown fluid or semi-solid brown material, alternate

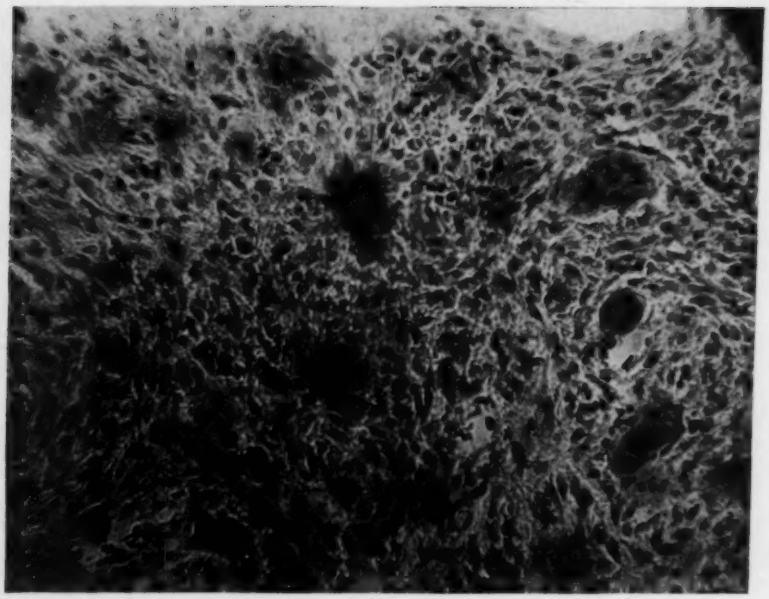

FIG. 2

Giant cells and spindle cells in hemorrhagic area at fibrous border

with a firmer brown and grey tissue. There are gritty plates and lines of greyish-white bone substance intermingled with firm uncalcified grey masses. Scattered throughout this tissue are softer areas, brown in color. The bone is easily cut with a scalpel."

Microscopic Examination.—The tissue was examined before and after decalcification. It was stained with hematoxylin and eosin, carbol fuchsin and gentian violet. Free hand and microtome sections were made.

The encasing wall is newly formed vascular connective tissue. New bone trabeculae coursing in various directions are numerous immediately beneath, and partly incorporated in, this tissue.

The cysts contain red blood cells, intact and in various stages of degeneration, giant cells, and young fibroblasts. These are deeply pigmented with blood pigment. Surrounding the clots and disintegrated blood cells are large, round, oval and spindle cells organizing connective tissue walls. These cysts are round, oval, or irregular in shape. Smaller cavities and cysts are in the cellular and fibrous walls of the larger ones. The innermost lining of the walls is typical cellular embryonal tissue,—round, oval, spindle, and giant cells with centrally placed nuclei. The giant cells predominate in some. Next is cellular, vascular-forming, fibrous tissue containing newly formed bone. In some areas the cells are in a syncytium, or their outlines are faintly marked, resembling callus. In others the cells are enclosed in a more or less definite fibrous tissue, containing hematoxylin stained granules (bone salts). These cells lie in lacunae with variously developed canaliculi. Some have no canaliculi and resemble cartilage cells. Some lacunae contain two or three cells or a single cell with a large irregular or round nucleus.

The bone is not densely calcified, and there are few areas of lamellation. Haversian canals are irregular in outline and contain myxomatous tissue. Some are lined by osteoblasts. There are a few areas of cartilage. Here one sees a transition from cell masses to callus to cartilage and bone.

Irregular bone trabeculae, with no definite direction, are formed in the cyst walls. A few of these are lined by osteoblasts. They are pigmented with blood pigment.

The basis of all these cell changes is a vascular congested embryonal tissue, rich in giant cells, large, irregular or spindle-shaped cells and red blood corpuscles (intact or broken down). Some of the vessels are varicose, others are occluded by cellular and fibrous tissue. The fibrillar, bone matrix, connective tissue and cells are all stained with blood pigment remnants of the original or subsequent hemorrhage.

SUMMARY

In the case reported we have a new growth of tissue, due to trauma with hemorrhage. The hemorrhage, coagulation necrosis, altered circulation and proximity to bone favored the formation of bone in the organization of the embryonal tissue, formed in the natural attempt at repair.

There are seen various transformations and massing of these young cells. Osteitis fibrosa, hemorrhagic osteomyelitis, and giant-cell tumor of bone have their representations in the microscopic pathology of this ossifying hematoma.

APPENDIX

Since writing the above there has come to my attention a case which throws some light on the pathology of modified circulation in relation to bone.

Female, age fifteen. Pregnancy, Caesarian section, infection.

Infusion of saline solution at the time of operation. Death four days later.

Autopsy shows a diffuse hemorrhagic pigmentation in muscle and at periosteum of the rib at the site of hypodermoclysis. Microscopic examination demonstrates fine granular pigment in muscle periosteum, convexity of rib, and marrow.

The convexity of the rib (site of hemorrhage) differs from the pleural side. The pleural side is unusually dense, the bone cells stain poorly and the haversian canals are quite narrow. It is not pigmented. The convex side is oedematous, loosely meshed, fibrocellular bone. It is readily cut, densely pigmented at the periosteum, containing free red blood cells and fine brown granular pigment.

The periosteum is cellular, loosely meshed and eighty microns wide. It appears continuous with haversian canals as swollen, cellular, young connective tissue following blood vessels into a cellular bone matrix resembling fibrocellular forming bone.

Channels, one to two microns wide, throughout the cortex—widened lymph channels—are packed with blood pigment. Lacunae and bone cells are pigmented. There are few remaining well defined lacunae; some resemble Virchow bone territories.

The bone cells are all enlarged and well stained. The nuclei are multilobulated or completely divided. Some cells have a halo about them—widened lacunae.

The bone resembles cellulofibrous osteoid as seen in callus or in metaplasia of bone in osteitis fibrosa.

The marrow trabeculae are numerous; they are dense like the bone of the pleural side of the rib. Their cells are in well formed lacunae and stain normally. The marrow is congested and pigmented with blood pigment, but not so densely as is the cortex of the convexity of the rib. It is densely cellular. The cells are mostly large, round, and spindle-shaped. Next to the trabeculae they are massed, like forming osteoid tissue, and are separated by a fine reticulum connecting them with the bone.

In the center are numerous megalokaryocytes, myelocytes, and nucleated red blood cells—reversion to the embryonal.

Here is a case where trauma (hypodermoclysis) caused hemorrhage at the rib and saline solution carried the blood and pigment into the adjoining bone, causing the softening and hyperplasia of the dense cortical bone. The time elapsed between the injection and autopsy was four days.

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DISCUSSION

Dr. E. L. Eliason, Philadelphia, Pa.: In the last ten years there have been something like fifty or sixty articles written on the condition known as myositis ossificans, traumatic ossifying hematoma, and calcifying hematoma. The confusion of these terms throughout the literature still exists. This confusion apparently is due to the failure to have recognized the pathology underlying the condition. Dr. Cone today is illustrating a basis for the etiologic pathology, so to speak, to supplement some of the other theories.

The condition is not common. In a series of something like 16,000 bone cases that have occurred and been operated on at the University Hospital by Dr. Pancoast, there were only twelve cases that fell into this group of ossifying hematoma or calcifying hematoma or myositis ossificans. The terminology has been used indiscriminately, and that is one reason why I have had occasion to look into this subject after having had cases illustrating it.

In regard to the argument about calcifying hematoma, Dr. Cone has shown slides indicating that you have true bone present. C. A. Stone, C. D. Stone and Oliver have all taken specimens showing it is true bone and so, I think, we can discard the term "calcifying hematoma".

With regard to myositis, two or three men have shown that this condition can occur in the absence of muscle tissue. Marshall has shown a case following the rupture of the acromioclavicular ligament. I personally, have had a case occurring in the lower end of the triceps tendon. Other cases are on record where the condition has appeared in the absence of muscle tissue. The predisposing factors that are common in these conditions are closed trauma, hemorrhage under pressure, and probably injury to the periosteum, or at least to fibrous tissue and connective tissue in close proximity to the periosteum. With all these facts it seems that we ought to come to some conclusion as to limiting our diagnostic nomenclature, so that "ossifying hematoma" would probably cover the whole group.

We are particularly interested in it from the standpoint of the cause, because that interests us from the standpoint of diagnosis and treatment. In diagnosing these cases we find them usually in youth; very few cases are in older people. The vast majority of the patients are under thirty years of age and of these, most are between ten and fifteen years of age, — that is, they are found in the period of growing tissue. Second, they usually give the picture of injury: a bruise that swells, the swelling reduces in ten days or so, and in about the same time it begins to get hard, crippling, and painful and then the x-ray shows a shadow. That shadow increases for eight or ten weeks, then the condition subsides, and the patient gets better.

From the standpoint of diagnosis you must consider sarcoma because sarcoma occurs from slight trauma and is rapid in appearance, but it is not crippling, and pain is not a prominent feature. An x-ray picture of the case will make the differentiation.

From the standpoint of treatment it is important to recognize the course of the disease, because if you operate on these cases before the cessation of activity or before there is regression, you will get a recurrence which will lead to the diagnosis of sarcoma unless you read the picture carefully. Dr. Coley has reported a case of myositis ossificans with sarcomatous degeneration. Carnett has reported a case in which the two were confused, but the ultimate course showed metastasis and the postmortem revealed sarcomatous degeneration. Bull reports four cases incorrectly diagnosed as sarcoma. So it behooves us to be careful in that respect.

As regards treatment, it is best to let them alone until they subside and then operate only if they interfere with the function. Palliative treatment is that of rest, gentle massage, — not the pump-handle activity we are too prone to give to the stiff elbow.

These cases are interesting from the standpoint of treatment. They do well if their surgical treatment is left until the subsidence of activity, preferably until regression occurs. The chief indication for surgery is that of sarcoma as shown by these three or four gentlemen who have reported patients. That is not a real danger. The second indication is that of function.

CONGENITAL PSEUDARTHROSIS OF THE TIBIA*

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In 1924 I presented before this Association a paper on pseudarthrosis of the tibia in children. The presentation of that paper was prompted by the fact that in a report prepared for the Section on Orthopaedics of the American Medical Association (1923) on non-union in fractures, I had noted that although in forty-four cases of non-union of the tibia the percentage of success was eighty-one and eight-tenths; of eight cases in children the percentage of cures was only twenty-five. If the children were not considered and only the adults counted, the percentage of success would have been ninety-four. In the paper in 1924, I reported nineteen cases in which the fractures were sustained before the age of puberty. Fourteen of these were operated on with five cures (35.3 per cent.), but in three cases of typical congenital pseudarthrosis the operations were all failures. In view of this unfavorable result I am bringing up today for your consideration and discussion this group of congenital pseudarthrosis of the tibia. I shall report on the subsequent course of the cases previously presented, so far as I know it (in five cases), and on two others observed since then.

It is necessary to turn to the Italian and French writings for information on the subject. Gasne's classification, perhaps the most simple and at the same time comprehensive, consists of four groups: (1) cases in which distinct anterior angulation is present but fracture was not present at birth; (2) cases like those in the first group, but with the development of pseudarthrosis after trauma or after an operation for correction of the deformity; (3) cases in which pseudarthrosis was present at birth, and (4) those in which there is an unaccountable condition in which the child appeared normal at birth but, following perhaps slight trauma, a fracture occurred which has become pseudarthrosis.

Codivilla[2] classified the cases under three groups: (1) those in which usual anterior angular deformity exists, (2) those in which there is typical pseudarthrosis, and (3) those in which there is a greatly exaggerated condition of the first and second groups with much loss of bony substance in both bones.

The etiologic factors concerned and the poor response to treatment have been variously discussed but nothing definite has been established. Frattin believed that intra-uterine pressure, due to amniotic cords or adhesions, might be a factor. Codivilla[1], at a meeting of this Association in

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1906, stated that he believed there was evidence of former adherence of the affected part to the amniotic membrane. His idea was that some mechanical cause might have disturbed the development of the part and produced permanent alterations of the tissues, rendering them deficient or nullifying their osteoblastic power. He stressed the importance of the periosteum and attributed the poor nourishment and undersize of the lower fragment to poor periosteum. In a paper published in Italy a year later[2], he again emphasized the belief that there was embryonal lack of development, due to inactivity of certain cells, possibly a congenital lack of development of the nutrient artery, which so starved the bone cells that they could not exhibit their normal osteogenic power. He called attention to the better nourishment of the upper fragment, due to its being surrounded by more vascular structures. All observers have commented on the fact that the general condition of the patients is usually good, and emphasized that whatever the cause may be, it must be local.

The various operative procedures advanced may be grouped under four headings: (1) the Italian method advanced by Reichel and practised by Codivilla, consisting of a cutaneous osteoperiosteal pedunculated graft swung over from the sound tibia to the pseudarthrosis; (2) bone-grafting, either by the inlay method of Albee or the massive method; (3) the osteoperiosteal graft (Delangiere), either as a free graft from the opposite leg or swung down from the upper fragment, and (4) shortening the leg enough to get good side-to-side apposition and approximation of the fragments. The Italian method is complicated and tedious, and for this reason is rarely used. I have not used it. The inlay or massive graft would seem to offer, at least to American surgeons, better results, but my results have been poor with both. French authorities are the chief exponents of the osteoperiosteal graft, although Codivilla, in 1906, reported its successful use in a girl aged seventeen. The ordinary plastic method of side-to-side apposition was satisfactory in one case in my series. Putti, in a personal communication, has granted the all too great frequency of poor results in these cases. At the French Congress of Surgeons in 1922, he reported eleven failures in thirteen cases.

In the seven cases in this series, which I have interpreted to be true congenital pseudarthrosis of the tibia, all of the patients had the typical angulation and deformity of forward bowing in the lower third of the tibia at birth. In four cases, the fracture was definitely noted either at birth or within the next few days. In three, although deformity was noted at birth, the fracture and subsequent pseudarthrosis followed correction of the malposition. It is quite probable in these three cases that mobility was present at the site of deformity at birth but examination was not made to determine this. In four cases, however, there was no question about the mobility having been noted by the parents. Six of the seven patients were males. The ages at which the children were seen varied from six months to seven years, with an average of three and seven-tenths years. All but one child had been operated on, most of them several times.

REPORT OF CASES

(Cases 1 to 5 inclusive were reported in 1924)

CASE 1. A normal-appearing boy, aged seven years, was seen at the Mayo Clinic in November 1914. A fracture in the lower third of the left tibia was noted a few days after birth. Labor and delivery had been normal. The child had been operated on at his home; a metal plate was applied but was removed later because of persistent non-union. The Wassermann test was negative as was also that of his father.

Typical pseudarthrosis of tibia and fibula, with marked mobility, and outward and forward angulation were noted on examination. The bone was shortened seven and five-tenths centimeters, and the ends were overlapped and atrophic. The fragments were exposed and dissected loose, the fibrous tissue was removed, and a metal peg put through the os calcis to provide skeletal traction. The child was put to bed and the leg was put up in extension; at the end of three weeks the deformity was well corrected, and a plaster-of-Paris cast was applied. Persistent bronchitis prevented further surgical procedures at this time.

Six months later an inlay bone graft was applied. The operation was technically satisfactory. The economic condition of the family made it necessary for the child to be taken home after three months. The family physician removed the cast after another three months and reported that union was complete. The patient was not heard from and all was thought to be well, until several years later when an answer to an inquiry brought the information that the fracture was still ununited, and that there was extensive shortening. What was believed to be union evidently had melted away and pseudarthrosis had again formed. Perhaps if prolonged protection with a walking caliper had been insisted on, the result would have been different.

I have not been able to get in touch with this patient, except to learn that his family physician saw him in 1926, and at that time the pseudarthrosis was still present.

CASE 2. A boy, aged five years, was examined in August 1922. The Wassermann reaction on the blood was negative. Fracture in the lower third of the left leg had been noted at birth; the delivery had been instrumental. Two operations had been performed elsewhere.

A draining sinus was found and at exploration a silver wire was removed. The patient returned November 10, 1923; the sinus had healed. A large piece of bone was removed from the mother's leg (the blood grouping being satisfactory) and used as a graft to bridge the fracture line. The bone was put on as a massive graft and held in place by beef bone screws. Osteoperiosteal pieces were also placed around the fracture line. On the fourteenth day the child's temperature rose and drainage occurred. The graft was left in place until March 15, 1924, when it was removed; there had been a feeble attempt at union. In June 1927 pseudarthrosis was still present.

CASE 3. A girl aged two years was examined in the clinic in June 1920. At birth the legs were bowed, the left more than the right. About the fourth day the family physician manipulated the leg and after this the child cried with pain when the leg was touched. At eight months a consulting physician diagnosed fracture in the lower third of the tibia. When the child was eleven months old an open operation for the fracture was performed, the bones being sutured together with catgut. Non-union resulted.

Examination disclosed pseudarthrosis of the left tibia at the juncture of the lower and middle thirds with a considerable amount of atrophy of the fibula. The child's general health was not good and her appearance was suggestive of rickets. The hemoglobin was fifty-five per cent. The Wassermann test was negative. Operation was suggested, but not urged. A special diet and tonics were prescribed and the child dismissed from observation.

Since then she has been operated on twice elsewhere, both times by the same surgeon and without union: first by exposure of the fragments and suturing with kangaroo tendons, and later by autogenous bone graft. The pseudarthrosis persists and the child is now getting about by the aid of a splint.

CASE 4. A boy, aged six months, was examined in the clinic in August 1920. The fourth day after birth the mother noticed a fracture in the lower third of the left leg. The delivery had been instrumental.

Pseudarthrosis of the lower third of the tibia and fibula was found at examination. Because of the child's age, operation was not advised. In May 1924, the mother reported that nothing had been done and pseudarthrosis still existed. It has not been possible to trace the child since.

CASE 5. A boy, aged three and a half years, was examined in September 1922. The Wassermann reaction was negative. He had been born with an angular deformity in the lower half of the left leg. When he was twenty-one months old the bones had been fractured, and a plaster-of-Paris cast was applied, but union had not occurred. Several other operations were performed elsewhere without union.

A roentgenogram taken August 28, 1923, showed pseudarthrosis of the lower and middle thirds of both tibia and fibula (Fig. 1). The uncertainty of any surgical procedure was explained to the parents, and operation was not advised at this time. A splint was applied and the child was brought to the clinic for observation from time to time. He was provided with a walking caliper; in May 1927, union could not be determined but there was less mobility at the site of fracture and the fragments showed evidence of more calcification (Fig. 2). The parents had faithfully carried out all

FIG. 1

Case 5. Typical pseudarthrosis of tibia and fibula. The pointed extremities of the fragments and the osteoporosis are shown.

FIG. 2

Case 5. Same patient as that shown in Figure 1, four years later; increased density of ends of fragments and less osteoporosis of shafts of bone are shown.

FIG. 3

Case 5. Good bony union six and a half months after operation. The patient was still using a walking caliper splint.

instructions and had kept the caliper splint in good repair. The child was in excellent health and the bones showed better density, and inasmuch as operation had not been tried, I carefully explained to the parents the relatively small chance of success, but added that I believed an operation carefully planned and carried out should be performed.

July 9, when the boy was eight and a half years old, a massive graft taken from the opposite tibia was applied to the carefully prepared fragments. The graft was held firmly in place by loops of double No. 2 chromic catgut wrapped around the fragments and tied securely over the graft. Care was used to remove some of the rich spongy bone from the upper end of the sound tibia by aid of a curet, and pack this in and around the fracture line. Examination on February 3, 1928, showed good union (Fig. 3). A new caliper was fitted and a night splint is to be worn. The child is to return for observation during the summer.

Case 6. A boy, aged five years, was brought to the clinic September 29, 1919, on account of deformity of the left leg. His mother said that delivery had been a foot presentation, and that the typical angular deformity had been noted at birth. Eighteen months before examination in the clinic, osteotomy had been performed at his home to straighten the leg. The cast was left on three months, but the child complained of great pain when he attempted to walk. The leg gradually bowed again.

Examination disclosed non-union with malposition at the juncture of the lower and middle thirds of the tibia. The fibula was fractured and not firmly united (Fig. 4). The Wassermann reaction was negative.

October 9, the fragments were exposed and freshened; by stepping them, good position (Fig. 5) was secured and maintained by the aid of a beef bone screw put through the fragments at an angle. In spite of the most painstaking care union did not follow (Fig. 6). Calcium and phosphorus cod-liver oil were given and Collop's parathyroid extract was injected without avail. During this time the boy wore a walking caliper brace. Finally, in October, 1926, when he was twelve and a half years old, operation was decided on. He was showing the beginning changes of puberty in voice and pubic hair. October 14 the fragments were again exposed and freshened. There was considerable angulation, so that in straightening the leg it was possible to secure good side-to-side apposition over a surface of at least four centimeters. The medullary cavity in both fragments was opened and the fragments fitted accurately. While they were being held tightly together, two beef bone screws were placed so as to maintain the position. A free graft was not used, but multiple bone chips, consisting of periosteum and the cortex beneath, were packed around the fracture line (Fig. 7). Examination, January 2, 1928, disclosed firm, bony union (Fig. 8); up to that time (one year and three months), a walking caliper had been worn.

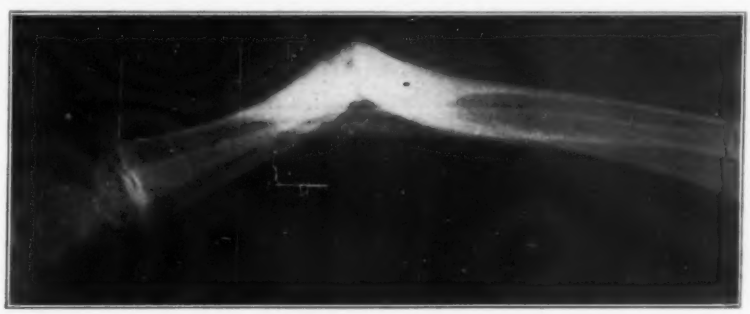

Fig. 4

Case 6. Pseudarthrosis. Angulation had been present at birth.

CASE 7. A healthy-looking boy, aged three years, was first brought to the clinic in July 1924. Delivery had been normal, but about ten days after birth it had been noted that the left leg was crooked. The Wassermann reaction was negative. A surgeon was called, who corrected the line and applied a plaster cast, but union did not result. Seven months later an open operation was undertaken and the ends of the bone united with kangaroo tendon.

Examination at the clinic showed that the bones had not united. Operation was discouraged on account of the child's age and he was provided with a walking caliper brace.

In September 1927 the parents brought the boy back for operation and, although we felt that this was not the most favorable time for operation, circumstances seemed to demand that at least one trial should be made. The fragments were exposed and freshened and a large graft removed from the mother's tibia (the blood group being the same) and applied by aid of a beef bone screw to the upper fragment, but on account of the extensive osteoporosis, by aid of wire to the lower fragment. Unfortunately, a

FIG. 5 FIG. 6 FIG. 7 FIG. 8

Fig. 5. Case 6. Unsuccessful result three months after first operation. A bone graft had not been used.

Fig. 6. Case 6. Same patient as that shown in Figure 5, six years later. Increased density of tibial fragments and extensive atrophy of the fibula are shown.

Fig. 7. Case 6. The fragments have been freshened, firmly apposed, and clamped with two beef bone screws. Multiple small osteoperiosteal grafts were packed along the fracture line.

Fig. 8 Case 6. Firm bony union of the tibia seventeen months after operation. Absorption of beef bone screws and increase in size of fibula are shown, although non-union still persisted.

somewhat virulent infection followed and it was subsequently necessary to remove the wire and most of the graft. The mother's leg healed by first intention. The child's leg has not united to date.

COMMENT

Operations were performed on five of the seven patients with only two successful results. Certainly this percentage behooves careful reconsideration of the selection of cases and types of operation. Cases are sufficiently rare so that a discussion of even such a small group may tend to clarify an unsatisfactory situation. The chief difficulty in these cases is, I believe, that an attempt is made to awaken to physiologic activity, tissue that is in extremely deep inertia. The two successful cases in the series were under observation for a number of years. After a failure in one of them, almost seven years was permitted to elapse before the time was opportune for further operative procedures. As I stated in 1924, I believe that the response of these patients to surgery after puberty is very much more satisfactory, and that the later the fracture has been sustained the better the operative risk. It should be noted that I am discussing here only typical congenital pseudarthrosis, Gasne's first, second, and third groups. I am not considering fractures sustained in infancy or childhood wherein there was no deformity at birth.

SUMMARY

No matter what the cause of congenital pseudarthrosis, nearly all observers are convinced that it is local and not general. A sufficient number of calcium and phosphorous blood readings have been made in this series and others to show, in the light of present knowledge, that it is purely a local condition.

Any deformity that may be present must be carefully corrected either before operation or at the time of operation, so that forces will not be acting to pull the fragments out of alignment.

Before operative procedures are undertaken, the child must be in the best possible state of general health and he should be walking erectly with a caliper, so that the lines of weight-bearing are as nearly normal as possible. Massage of the part should be carried out to stimulate the circulation: heliotherapy in the summer, the mercury-quartz light in the winter, and contrast baths of hot and cold. In the aggregate, I am sure that all of these help. Cod-liver oil should be given almost constantly, and of course the diet should be such that plenty of essential vitamins, and calcium and phosphorus are provided. The administration of preparations from endocrine glands is entirely empiric and although they were used occasionally in this series their effect was not definite.

The bones should be examined roentgenologically at intervals to note the increase in metabolism as evidenced by increase in the size of the lower fragment and the enhanced density, particularly in the area of the fracture.

In spite of the poor results reported by practically all surgeons, I believe that if the child is in excellent general health and an improvement in the condition of the fragments is noted after supervision for a time, a well planned and well executed operation is worthy of trial. Just what the exact details of that operation will be must depend, of course, on the surgeon. When possible, bony contact of the fragments should be secured, even at the cost of slight shortening. In certain cases, in order to secure this, the fibula will have to be fractured. An autogenous massive graft, held closely to the freshened fragments I believe to be the best; of almost equal value, however, is the packing of as much spongy bone as can be obtained about the fracture line and the edges of the graft where it comes in contact with the fragments. Spongy bone, which can be obtained from the vicinity of the epiphyseal line by running a curet up through the opening from which the graft was lifted, is rich in osteogenic properties. The good results with the osteoperiosteal graft reported by French surgeons is encouraging and worthy of more attention.

The younger the patient, the poorer are the chances for success. I would not advise operating on any child less than six years of age. About the time of or after puberty is better. Therefore, if one attempt has failed, rather than cause more scarring and risk of infection by another operation, the child should be carried along with a well-fitting walking caliper until the age of puberty. Amputation should not be countenanced until all other means have failed, and certainly not until after puberty.

In the series of cases herein reported operation was performed in five cases with successful results in two (forty per cent.).

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DISCUSSION

Dr. Fred H. Albee, New York, N. Y.: I think we are indebted to Dr. Henderson for bringing up for discussion such a difficult surgical problem as congenital ununited fracture or pseudarthrosis.

During the past twenty years I have had an opportunity to observe and operate upon a very large number of pseudarthrosis cases of all ages. The congenital type is not a frequent occurrence, and my experience has convinced me that this type is far more unfavorable than the ordinary case of adult life. The reason for this is, I believe, largely

a local one, in that there is an excessive amount of scar tissue in and around the pseudarthrosis. The bone ends are conical and there is an extensive amount of osteoporosis. The diameter of the bone fragments is much diminished.

I believe the most important features of these cases compared to non-unions in adults are the amount of scar tissue, and the lack of adequate blood supply. Therefore one should give this first consideration in the general plan of the operative procedure. Osteogenesis is in direct relation to the amount of blood supply, as pointed out at the Interurban Orthopaedic Club by Johnson of Johns Hopkins University, and subsequently reported in the *Journal of Bone and Joint Surgery* (IX, 153, Jan, 1927).

From very careful and extensive experimental work, he proved that the relative potentialities as to both blood supply and osteogenesis of the marrow side of the bone cortex as compared with the periosteal side were three to one. If this is true, and I am convinced it is, then we must certainly plan in every operation for pseudarthrosis of all ages to have the most generous contact of the graft marrow with the marrow of both fragments. This can be accomplished in no way as well as by the massive inlay graft.

In operating upon congenital pseudarthrosis one should be even more particular about this feature of his operative plans than in adult cases.

In bringing this about, I do not use the twin saw, but split the long conical osteoporotic end of the fragments with the single saw for a distance of one and one-half to two inches, as the mechanical conditions indicate. Then, by means of an osteotome, the bone fragment is split beyond the saw-cut which is thus opened into a long wedge-shaped cavity. The graft from the other tibia — double wedge-end in conformation, its central portion including the crest of the tibia in order to have additional strength — is removed by means of a single saw and inserted by the usual inlay technique.

I have had a considerable number of congenital pseudarthroses, and although I have not had one hundred per cent. good results, still they have been very satisfactory.

One of the most interesting cases was that of a young girl of five years, referred to me by the late Dr. Clarence MacWilliams of the Presbyterian Hospital, New York, who was much interested in the problem of pseudarthrosis and had done an extensive amount of work along this line. He had operated on this case seven times, the majority of these operations having been bone-graft operations. He finally referred the case to me with the statement that he was through.

In May, 1916, at Post-Graduate Hospital I operated on this case, carrying out the operative procedure of the type I have mentioned above. Union promptly occurred and this case, which has been under my observation since that time, has an excellent result.

Dr. Willis C. Campbell, Memphis, Tenn.: I have had one case of a child, aged two, with congenital fracture in which efficient graft was obtained from the mother, as demonstrated by the x-ray, which is reproduced in the slide.

You will note that silver wires were employed for fixation purposes as the quality of the bone was such that it was impossible to secure internal fixation by any other method. There is no shortening in this case, and the child has worn no brace for over a year. There is solid bony union with perfect function. We are employing homologous graft from the mother or some other member of the family in cases of this type.

Dr. J. Torrance Rugh, Philadelphia, Pa.: I would like to give a word of warning regarding a remark made by Dr. Henderson, that is, the too frequent use of x-rays after the placing of a bone graft may interfere with the repair in fractures.

THE PROBLEM OF OSTEO-ARTICULAR DISEASES OF VASOMOTOR ORIGIN

Hydrarthrosis and Traumatic Arthritis: Genesis and Treatment

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There is nothing so common in bone pathology as traumatic hydrarthrosis, nothing except what we call traumatic arthritis. However, if one of us were asked suddenly about its genesis, we would make some elusive answer or try to satisfy our interlocutor with some superficial explanations.

Doubtless some hydrarthroses follow a blood effusion in a joint, some others seem to have their origin in a bone crack, in a foreign body, or in a meniscial displacement. In the same way, we may see a mechanical arthritis provoked by partial fracture or displacement of the articular surfaces.

If these facts explain certain cases, they do not explain all; of course, foreign bodies, bone cracks or meniscial displacement often exist without any hydrarthrosis or arthritis. Thus in general we are not at all aware of the reasons why hydrarthrosis or arthritis occur. A few days after a fall or moderate blow on the knee, without hemarthrosis or fracture, a serous effusion will appear and rapidly distend the joint. The exudate is clear, straw-colored, without red cells or leucocytes. If removed by puncture, it soon reforms, and we have no idea how long it will last.

Naturally the surgeon will cautiously prescribe rest, dry heat, immobilization or massage, hot poultices or aspiration. But none of these methods of treatment will give relief with certainty. Hydrarthrosis persists, whatever is done. Finally it disappears, a long time after the patient has lost all faith in healing and has given up his doctor.

If the traumatism involved some joint with poor synovia (shoulder, elbow, wrist or ankle), there is no effusion, but the joint becomes difficult to move or completely stiff, and painful. Thus we have traumatic arthritis. Some arthritides are healed by thermal cures, but most of them are aggravated in these watering places. Nearly all, even after healing, leave the joint tender, with a cracking movement, as in chronic rheumatism.

A great number of facts which the author has observed during the last years enable him to explain on a physiologic basis these traumatic syndromes and to give precise indications about their treatment.

The patients spoken of evidently had no tuberculosis, gonorrhoea, or syphilis, every test having been done.

The facts will be presented first, and interpreted later.

CASE 1. A man, twenty-five years old, had fallen on his right knee from a wagon, three months before he entered the clinic. Immediately after the accident he returned to work, and nothing happened during ten days. Then, walking became difficult, the knee swelled progressively, and there developed an enormous hydrarthrosis. He was obliged to stop work, and soon after to stay in bed.

On October 26, 1927, the date of entrance, I found the knee very distended by hydrarthrosis, the articular space exceedingly painful, and the quadriceps muscle atrophied.

X-ray examination showed a marked decalcification of a lacunar type, involving both the femoral and tibial epiphyses.

Aspiration yielded a straw-colored fluid without microbes or cellular elements. After aspiration, effusion reformed almost immediately, even after two other punctures. The aspirated fluid was injected into guinea pigs, but gave no tuberculous reaction.

On November 24, a synovectomy was performed, with normal course. The synovia was found very thickened, vascular, purple and covered with villi. It was distended by citrine fluid. Three weeks after operation, the patient had recovered the former use of the knee. In January he was seen again with a normal joint and normal motion.

Microscopic examination showed "typical subacute synovitis", aseptic inflammation. The internal layer was swollen, villous, vascular with extensive formation of new capillaries. The connective tissue was oedematous, with numerous plasmocytes and a lymphocytic infiltration surrounding the blood vessels. There were no polymorphonuclear leucocytes. The surrounding cellular membrane seemed hyperplastic. The external layer was compact, rather fibrous in its peripheral portion, but very vascularized in its internal portion. Many blood vessels penetrated the sclerous part, running towards the internal layer.

This is an example of hydrarthrosis which appeared ten days after trauma. There was no hemarthrosis or fracture, or any sign of infection, only subacute aseptic synovitis with decalcification of the femoral condyles and the superior tibial epiphysis.

CASE 2. A farmer entered the clinic in March for pain and disability in the right shoulder. He had no pathological history. On September 16, 1926, he forcibly cracked his whip and suddenly felt extreme pain in his shoulder. The pain disappeared, so that he could go on working, and there were no symptoms during the next few days. But a week later he felt dull pain and disability in his shoulder. After three months he stopped all work, completely incapacitated.

When the author first saw him, all active motion of his shoulder was blocked; passive motion was impossible because of pain. At the slightest trial, one noticed a cracking sensation in the shoulder region. Pressure revealed pain at several points, chiefly in the internal part of the joint. There was but little atrophy of the muscles of the shoulder. When the patient was told to let his arm hang down by his side, the hand and the forearm became cyanotic. Pachon's oscillometer indicated an obvious reduction of oscillations.

The roentgenogram showed an important rarefaction of the spongy tissue of the humeral head, of the whole glenoid fossa, the acromion and the coracoid. There were three great osteoporous holes: two on the inside of the humeral head, one in the capsula near the glenoid fossa, and some other little ones.

On March 8, 1927, the author performed an internal arthrotomy. The synovia was hyperaemic, purple, very thick. The inner side was covered with small polypous villi. The synovial space was filled with clear fluid, which bacteriologic examination proved to be sterile. The upper extremity of the humerus being widely exposed, there was a superficial destruction of cartilage. This corresponded exactly with the painful area, which had been previously traced on the skin. The cartilage in this zone had become thinned, reddish, detached from the underlying bone. Its margin had an abnormal appearance, though it had not the well known features of arthritis deformans. With a gouge the osseous border was removed and the corresponding segment of cartilage. It was obvious that even a feeble pressure with the gouge would detach *en bloc*

the whole cartilaginous covering of the head, as in tuberculosis. In places, where the underlying bone could be seen, it seemed to be congested and rarefied. The cartilage had a roughened surface. On the internal side of the joint, inside and under the biceps tendon, there was seen on the humeral head a point of thinned cartilage, detached from the bone and reddish in color. The whole zone, bone and cartilage, was removed *en bloc* and the wound closed. All pain disappeared after the operation, though there persisted some disability and vasomotor troubles in the hand.

Fragments of the synovia were inoculated into a guinea pig without tuberculous reaction.

The histological examination showed great alterations of the synovia, the cartilage and the bone. The removed synovial villi were most hyperaemic with plasmocytic infiltrations around the vessels. In some points the synovial tissue was transformed into fibrocartilage. The osteocartilaginous chips showed that hyalin cartilage had become fibrocartilage. In certain spots the fibrocartilage was invaded by very vascularized connective tissue, and in other places completely destroyed by giant cells. At the level of the destroyed cartilaginous zones mentioned above, there was seen active proliferating bone marrow, filling up the gaps of rarefied bone. The underlying osseous framework was being reabsorbed by osteoclasis.

Case 3. A man of forty-six entered the clinic on October 22, 1927, for pain in the right shoulder and complete functional disability. Last May he was struck on the internal part of his right clavicle by a sixty-pound lump of lead which fell from a height of six feet. He kept on working immediately after the accident and the following days. But after two or three weeks he began to suffer, to be impeded first in abduction of the arm, and soon in all movements of his shoulder.

At entrance, he was suffering when he raised his arm or tried to put it straight before him. He could not lie on the injured side. Pain was noted all over the joint, but more exquisitely on the internal portion of the humeral head. The biceps and all the muscles of the shoulder showed atrophy with active and passive complete inability. The muscular power of the arm, the forearm, and the hand was very much diminished. There was no tuberculosis or syphilis and general health was excellent. The oscillometric examination showed an increased amplitude in the arm and forearm of the injured side. The roentgenogram gave evidence of marked decalcification of the humeral head and the glenoid fossa with some lacunar spots of osteoporosis.

The patient was operated upon October 31. I performed first a sympathectomy on the subclavian artery, exposed between the two heads of the sternocleidomastoid muscle. I then laid bare the humeral head and found that the capsule was thickened and villous and that the cartilage was roughened. One could say that the synovia was growing over the cartilage. The cartilage had red spots. Some fragments were taken off for microscopic examination. The wound was closed and the postoperative course was quite normal. There was rapid improvement. On November 3, the patient announced that he was almost free from pain. He could raise his arm more than ninety degrees without suffering. Strength came back rapidly in the whole limb.

He was discharged on November 12, completely relieved from his pain, having recovered a very wide range of motion. When he came back a month later, he could raise his arm straight vertically without any pain. He was ready to return to work. The first of June 1928, he was seen again, completely healed.

The microscopic examination showed a thickened, sclerous synovia, very vascularized. Some points of the internal layer were covered with hyperplastic villi. This hyperplasia did not seem to be progressing, but it seemed to be merely a fixed lesion.

In these three cases we observe the same sequence of facts:

From eight to ten days after the accident, which does not leave any trace of injury (fracture or hemarthrosis), there appear functional signs of articular disease and pain. The functional troubles correspond to evolu-

tive lesions of the synovia, of the bone and cartilage; and in all three patients these lesions had an identical feature.

We have to explain the connection of these facts.

If we want to understand them, we must remember the oscillometric tests which I established in 1917[1]. They were recorded by Delrez[2], and by Albert[3], who experimented on the question and made it the subject of a very interesting doctor's thesis. Lately, my pupils Fontaine and Miloyévitch[4] repeated the experiments in my laboratory.

These oscillometric tests prove every traumatism in man to be above all a traumatism of "vasomotoricity".

Always, after a shock or a blow, though there is no wound or fracture, the peripheric nerve endings are excited and, by reflex action, will immediately disturb the equilibrium of the vasomotor system for a longer or shorter time. This disequilibrium* generally expresses itself by active vasodilatation: of course, everyone knows that a scratch or a hurt provokes instantly a rise of local temperature and a congestive blush.

In animal experiments, with suitable apparatus, one always records obvious changes in local and general circulation, if the animal's paw is submitted even to a slight traumatism.

As a rule these vasomotor changes are transitory, and in a few days everything returns to the normal state. Sometimes, however, the vasomotor disequilibrium persists for a longer time and vasodilatation will become a permanent state: this for reasons which are difficult to analyze, but probably dependent on an individual susceptibility of the sympathetic nervous system, or perhaps on the kind of trauma.

This vasodilatory state is not continuously the same: at the beginning, there is a more or less long period of *active* vasodilatation with local hyperthermia, with variations at different moments of the same day and alternations of *passive* vasodilatory stages. Finally, after some weeks or months, a state of vasodilatation with cyanosis becomes definite. But as a rule the active vasodilatory waves prevail for a long time, during which appear peripheral troubles of the skin, of the growth of the nails, hypertrichosis, muscular atrophy, and bony rarefaction in the skeleton.

For the present purpose we will concentrate our attention on the skeletal troubles.

Policard and the writer[5] have shown in these last years that, when there occurs active vasodilatation in a limb, bone will rarefy and lose its calcareous matter.

Periarterial sympathectomy, being always followed by active, vasodilatation, produces sometimes a momentary, real, acute decalcification. In studying those facts, we see that traumatic osteoporosis, the so called disease of Südeck, occurs in the same way. We are accustomed to see in this decalcification a result of functional inactivity or of immobilization of the joint. It is considered as a lesion of passive atrophy. This is a complete

*There is sometimes a short stage of vasoconstriction, but generally it is only transient.

mistake which comes from the fact that until now things were observed and studied only in their terminal stages. Indeed, when one sees an obvious decalcification two or three weeks after trauma without fracture, in people who never were immobilized, one is obliged to reform his judgment.

In fact it is easy in these cases to show, by oscillometric and thermometric methods, the permanent vasomotor disequilibrium, the signs of active vasodilatation, the local hyperthermia, which often is perceptible by simple touch*.

It does not seem that the products of bone destruction are to be absorbed by the bloodstream. There is probably local osteolysis, and the products of destruction probably remain in the same region. Pure decalcification without adipose transformation of the marrow is a phenomenon of absorption by active hyperaemia.

As one of its effects, hyperaemia creates real holes in the bony tissue, whose existence is confirmed by radiography and histologic examination; this was shown in the three cases recorded above.

When a bone has been previously injured by fracture or war injury, even several years before, the phenomenon of post-traumatic decalcification often progresses in a particularly fast and marked manner. The writer once found an actual melting of the patella in a patient whose knee joint was ankylosed for nine years. Shortly before his entrance into the hospital, he received a moderate blow on the knee. The anterior part of the joint became very painful. The skin at this level was red and hot. Apparently this was due to infection, but at operation a violent congestive condition was found, but no sign of infection. The patella was reduced to a kind of friable shell which was removed and which proved to be sterile. The patient recovered rapidly.

When we recall now my three observations, we find these three facts: *moderate trauma, epiphyseal decalcification, synovial lesions of a hyperaemic type.*

It seems that, if we remember the above mentioned effects of hyperaemia, we easily could explain their mutual relationship. The trauma, without injuring the skin, the joint, or the bone, produces active hyperaemia; this, progressively, occasions on the one hand a real subacute synovitis, on the other, bony rarefaction with a bad effect on the nutrition of the cartilage, the whole resulting in pain and functional disability.

One may be surprised to see a simple functional trouble (hyperaemia) ascribed as the origin of serious anatomic lesions. But after due reflection it seems to be a natural physiologic sequence. Of course, every surgical act we do, whether to repair an accidental or a surgical wound, depends on the simple fact that every traumatism provokes active vasodilatation. If things were otherwise, if operative traumatism would produce the reverse

*I am just now observing a patient who received a blow on his wrist three weeks ago. His hand and the lower third of the forearm still present a difference of three degrees Celsius with the healthy side. Actually there is no radiographic sign of decalcification. But there is pain and inability, and I am quite sure that these signs of osteoporosis will soon appear.

vasomotor phenomenon, that is, vasoconstriction; or if there would be no vasomotor reaction at all, *no aseptic surgery could possibly exist; repairing of our tissues could not possibly occur. It is because of the active hyperaemia which follows every traumatism of tissues—every operation being one—that the connective tissue undergoes new circulatory and nutritive changes, acquires new possibilities of evolution, and passes through the different histological stages which result in repair.*

In fact, in the cases where there exists permanent vasoconstriction, where circulatory conditions are poor, the cicatrization will not occur and the wound will not heal.

Post-traumatic hyperaemia, as we see, is the most common phenomenon we meet every day, but one to which we do not pay the deserved attention.

When, after accidental trauma, the hyperaemic reaction persists for a longer time than usual, there is no wonder that it will have biological and histological consequences. It is but natural that it will rarefy the bone and in this way hinder the nutrition of the covering cartilage. It is also natural that it should produce a thickening of the synovia, an oedematous swelling of its fringes and folds, and exudation of fluid. Policard states that the normal synovial fluid represents the liquid form of the fundamental matter of connective and cartilaginous tissue. When the synovia becomes very hyperaemic, its normal fluid will be more or less diluted by the oozing blood serum. Thus hydrarthrosis is established, and will persist as long as there exists the hyperaemic condition in the synovia. One is the fatal consequence of the other, and it is quite as easy to dry up by puncture the fluid of a hyperaemic synovia as it would be to drain the cask of the Danaides.

We may sum up our statements as follows:

Trauma of an articular region produces at this level a hyperaemic reaction. If this persists for longer than ten days, it results in synovial, osseous, and cartilaginous changes.

In the synovia (if it is one of great size like the knee) it gives a real subacute, aseptic synovitis with marked exudation of fluid, thus creating a hydrarthrosis.

In the bone it occasions active rarefaction, lacunar osteoporosis which is evident on x-ray plates. When rarefaction reaches the subchondral part, the cartilage becomes detached, shows nutritive troubles, and is even destroyed in some parts. Then we have what is called traumatic arthritis.

One could say that hydrarthrosis and traumatic arthritis are but *physiopathic* troubles. In studying them from the point of view of pathological physiology, we are enabled to understand their genesis and to carry out their treatment in a logical manner.

Of course these syndromes, at their first period of evolution, are liable to be reversed. They are results of an altered "vasomotoricity". Thus they can retrocede without leaving any sequel, if the vasomotor conditions are restored to normal. If they are left to their own evolution, they will, by the simple facts of their existence, create definitive anatomic lesions. Normally, their course of healing will then take two, three, or four years.

But then, bone, cartilage, and synovia show irretrievable alterations; it is no longer possible to restore the normal state.

The bone repair which finally takes place after a very long time is not a normal one: the malleable bone has been deformed by continuous pressure. When the bone undergoes regeneration, there appear little ossified patches on the margin of the capsule and the synovia, so that the final bone has the appearance of arthritis deformans. These sequelae of traumatic arthritis sometimes will be secondarily superimposed by a real mechanical arthritis which little by little will supersede and mask the initial disease.

It often happens that the patient forgets his accident, or that the practitioner, if he is told the story, pays no attention to such a trifling etiologic factor which did not break a bone nor even scratch the skin, whereas he sees obvious articular deformations. Therefore, he thinks that there was from the very beginning arthritis deformans, grafted on an arthritic constitution, or which was revealed incidentally by the trauma. This easy explanation generally satisfies the doctor and the patient.

After several years of careful study of the question, the writer is convinced that a great number of cases of arthritis deformans, involving a single joint, have exactly the physiopathic origin mentioned above.

What can be done to prevent this discouraging course of things? What can be done with traumatic hydrarthrosis or traumatic arthritis?

(1) In the very beginning, one must avoid massage, mechanotherapy, heat, every cause of hyperaemia. On the contrary, rest, cold water or ice should be recommended. No poulticing, but rather the old remedy of local blood-letting. I even have applied the leeches of our fathers in several cases of sprain with conspicuous results. Plaster immobilization is not useful, as there is no danger in a little movement, but the resumption of normal activity is not advisable.

(2) A little later, when synovial and osseous lesions are established, the situation is more delicate. There is still no use of forcible mobilization or massage. A very good thing would be hydrotherapy, as it is done at Aix-les-Bains, but without the massage: a simple pouring in a few minutes of 1200 to 1500 liters of hot water all over the body, which produces marked changes in general peripheric vasomotor conditions. The difficulty is to obtain in thermal stations hydrotherapy, without the usual kneading of the muscles and more or less forced mobilization of a stiffened joint, which is just the thing to avoid. That is the reason why many patients of this kind come back from the hydrotherapic cure with a joint more stiffened and more painful than before.

(3) In serious cases, the surgical treatment is the best way to put things right in the shortest time.

The author has performed divers operations on the sympathetic nervous system: sympathectomies and ramisections, aiming to change the altered vasomotor conditions. At first he was doubtful about the result. The results, however, were surprisingly good, and some of them were reported at the Société de Chirurgie in Paris in 1926[6] and 1927[7].

Three cases will be mentioned:

CASE 1. A young man, twenty years old, received four months ago a violent blow on the wrist. Pain and disability appeared but a few days later. They became so severe that the physician thought of tuberculosis and immobilized the wrist in plaster. When the author saw the patient, there was no oedema, no swelling of the joint, only severe pain hindering motion. The diagnosis of traumatic osteoporosis was confirmed by roentgenogram. A perihumeral sympathectomy was performed and the wrist immobilized. A month later the patient had taken off his splint, all pain had vanished. He had motion to a rather normal extent and declared he was cured. Two months after operation, x-rays showed a complete recalcification of the bones. The young man felt so well that he did not want to be exempted from military service and went into the army. He had no relapse.

CASE 2. A young woman had a slight sprain. Soon afterwards she had severe pain in her mediotarsal joint and the arch. The foot became oedematous and she was obliged to stop walking. The x-ray showed a very marked decalcification of the whole anterior and posterior tarsus. There was a cloudy shadow at the level of the scaphoid and the cuboid bones. A perifemoral sympathectomy was performed and two months later the bones of the foot had recovered their normal aspect. All pain had disappeared, and the patient walked as well as before the accident.

CASE 3. This man was a polish worker. After a severe blow on the left foot he presented inability and pain. There was no fracture. No treatment gave any relief. The patient stayed in bed, and for almost a year could not walk. He was finally considered to be a malingerer and sent to me with this diagnosis.

Examination showed the whole left lower limb to be extremely painful: the slightest touch upon the skin made him cry out. No movement was possible. The leg and the foot were cyanotic. There was evident atrophy in the foot, the leg, the thigh, the buttock, and even the left side of the back. Radiography showed extensive decalcification of the foot and the lower third of the leg.

Considering this wide distribution of his troubles, I performed a lumbar ramisection on November 22, 1926. The same evening pain and cyanosis had gone. The following day feeble movements were possible. Sixteen days after operation, the patient got up for the first time for eight months. He could bear weight upon the foot without suffering. Functional conditions improved progressively. The bone recovered rapidly its calcareous matter, and successive roentgenograms showed a very regular reconstitution of the bone which was absolutely normal after three months. At the end of March, 1927, the patient was discharged perfectly cured.

These cases, as well as the three mentioned above, and others—published elsewhere—prove the regular efficacy of sympathetic operations in traumatic arthritis.

When the author first undertook the study of these problems, he was afraid to limit the surgical treatment to a single operation on the sympathetic system, fearing that it would not be enough. Therefore, in the larger joints (shoulder or knee), an articular exploration was done at the same time, to verify the existing lesions and to take osteocartilaginous fragments for biopsy.

This proceeding allowed an understanding of the anatomico-pathological genesis of these syndromes which was unknown in its early stage. The operation acted as a local blood-letting and, for this reason, modified the vasomotor conditions by diminishing hyperaemia.

In the future I intend to limit the surgical treatment to sympathetic operations. Will they be sufficient in those enormous hydrarthroses of

the knee, one of which cases I described at the beginning of this paper? Twice I have treated them by early synovectomy with excellent results. But on the first occasion I shall try a simple perifemoral sympathectomy.

The facts reported here seem to me of great interest. First, they throw light on an obscure point of pathological physiology of bones and articulations, and this is of some value.

But they have a more general import. They show that real osseous and cartilaginous lesions follow a simple functional trouble of blood circulation. We are accustomed to think on an anatomical basis. We cannot imagine a disease without visible anatomical lesions. Most surgeons do not admit the existence of diseases due primarily to a functional defect. Now their existence is experimentally demonstrated by the described osteocartilaginous lesions of hyperaemic origin.

Our cases also show the frequency of inflammatory lesions following closed trauma. Bacteriology has educated us to see inflammation only where there is infection or toxaemia. This is an erroneous notion we must reform. Inflammation and inflammatory changes are essentially lesions caused by hyperaemia, whatever may be its origin. One of the most frequent causes of hyperaemia indeed is infection. But one ought to know that there are others, and trauma is one of these. It produces exactly the same anatomical features. Synovitis by hyperaemia is an example, and we now understand its mechanism.

There also seem to be new possibilities in prospect for sympathetic surgery applied to bone pathology on its actual physiological basis.

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CONGENITAL DISLOCATION OF THE HIP

Report of an Unusual Case*

BY JOHN RIDLON, M.D., CHICAGO, ILL. AND NEWPORT, R. I.

My purpose in reporting this case is to put on record two facts that are new to me:

1. The birth of the child was by Caesarian operation.
2. The false socket, in which the dislocated head has rested for more than six years, has developed an extraordinary shelf above the head.

In previous writings (See *American Journal of Orthopaedic Surgery*, April 1915), I have reported two cases in each of which I found a dislocated hip soon after birth, but when brought for operation at the time of election —when between two and three years of age—I found the hips no longer dislocated; also one case under treatment for congenital club-foot and thus under constant observation and when discharged walking without a limp, returned after six months with a spontaneously dislocated hip; and two other cases in which spontaneous dislocation occurred in undislocated hips while walking in the cast with the operated-on leg in right-angled abduction (one of these, a case of Drs. D. A. K. Steele and John L. Porter, proven by radiograms before and after operation); also, a boy of fourteen years who spontaneously dislocated a hip while bending backwards when standing; also, a very large man, fifty-six years old, who had led an active life as a policeman and believed his hips to be normal, was found in the radiograms to have two defective hips, the acetabulum in one embracing but half the femoral head and in the other only two-thirds of the head.

It is true that I have believed that some, perhaps many, so called congenitally dislocated hips were really *congenital*, but never before this case now being reported have I seen a case, feeling that I had positive proof that the dislocation might not have resulted either from the violence of the uterine contractions, or from the manipulation of the obstetrician.

The obstetrician who attended the mother of this child is a man of vast experience (Dr. M. H. Sullivan of Newport, R. I.). As this Jewish mother approached her time he examined her, decided that a vaginal delivery was not possible, called a surgeon of experience and skill (Dr. C. W. Stewart of Newport, R. I.), who agreed with the opinion, and who then performed the Caesarian operation assisted by Dr. Sullivan. Both of these gentlemen have assured me that there was no violence to the child.

When the child was about fifteen months old, Dr. Eugene A. McCarthy of Fall River, Mass., made the diagnosis of congenital dislocation. He writes me as follows: "This patient was admitted to the Newport Hospital on June 11, 1919, for congenital dislocation of the left hip. X-rays taken at the time revealed a dislocation of the left hip with some malformation of the head. Ether manipulation and reduction were attempted and a plaster spica was applied. X-rays were taken after the reduction of the hip, and the bone seemed to approximate very well with the acetabulum. The patient was discharged from the Newport Hospital on June 16, 1919. The case was transferred to Dr. W. R. MacAusland in July 1919."

*Presented at meeting of American Orthopaedic Association, Washington, May 1928.

The father of the child says that Dr. McCarthy did a second manipulation under an anaesthetic before the case was taken in charge by Dr. MacAusland. But of course he may be mistaken.

Dr. MacAusland has kindly sent me a copy of his record of the case. It is as follows: "August 29, 1919:—Patient has been manipulated two or three times for congenital dislocation of hip. X-ray shows the head still high, and also a twisted neck. Dr. W. R. manipulated again, and believes he made an anterior replacement. Patient to have x-ray and keep on cast for a long time. If failure, let go until three or four years of age, then have open operation done. February 12, 1920:—New cast. X-ray—Dr. George. April 28, 1920:—Eight months since operation. No complaints. September 28, 1920:—Clinically, hip seems in place. See x-ray and Dr. George's report." He writes me that Dr. George's report is as follows:—"Plates were made of both hips. The left acetabulum of course is flatter than the right. The relation of the head of the left femur to the acetabulum, with the femora rotated outward, does not seem to be normal. The head of the femur is at a higher level on the left than on the right. The space between the head of the femur and the acetabulum is somewhat wider. There is apparently some deformity of the neck of the femur. With the femora rotated inward, the levels of the head of the femora are more normal. It is practically on the same level on the left as on the right. There is still, however, considerable space between the head of the femur and the acetabulum."

The boy was brought to me, with the x-ray films, for examination on August 15, 1921. The father said that the cast had been off for about a year. The left leg was three-quarters of an inch short. The femoral head could be felt distinctly in front, and faintly at the back when the thigh was flexed and rotated inward as far as the stiffness would allow. Rotation and abduction were restricted almost completely.

Because there was so much stiffness and only three-quarters of an inch of shortening, I advised waiting a year before considering further treatment.

FIG. 1
Nov. 2, 1921.

FIG. 2
No change in position after six years.

Two months later he was taken for examination to Dr. Robert Soutter (October 3, 1921). He found, "the acetabular shelf poor and oblique; there was a great deal of torsion and the capital epiphysis was small and round. There was also roughening of the acetabulum." He advised, "reduction of the dislocation by manipulation".

I examined the boy again the following summer (June 7, 1922). The head of the femur could still be felt in front; the shortening had not increased; there was improved range of motion, but he still lacked inward rotation. I told the father that I believed that I could replace the hip by manipulation, but that I could not give assurance that it would remain in place; that it might relapse or even be worse than if left alone. It was decided to wait another year. I examined the boy in the summers of 1923, 1924, and 1925. X-ray films were made. A new socket seemed to be forming. The position of the head had not changed. I did not examine the boy in 1926.

Meantime he was examined in New York by Lorenz, and was told that no treatment was of use.

I next examined the boy on September 28, 1927 and found the femoral head still where it was when first seen by me in 1921. The range of motion had increased, but he still lacked inward rotation, abduction, and hyperextension. The father wished advice as to a cutting operation. We went to Boston and Dr. George made x-ray films with the boy lying on his back, as the others had been made. They showed the head in the same position, but with an increase of the density of the bone around the false socket. Then to the office of Dr. Brackett and Dr. Z. B. Adams. Examining the boy, Dr. Adams did a thing I had not done: He had the boy stand with his full weight first on one leg and then on the other, and was of the opinion that the head of the dislocated hip positively rode upwards. He also thought the head was bent forward and downward from its normal relation to the shaft. He said that the hip ought to be left alone; or replaced by a two-step operation: the first, an osteotomy to correct the twist of the neck; the

Fig. 4
Standing with full weight on leg of dislocated hip.

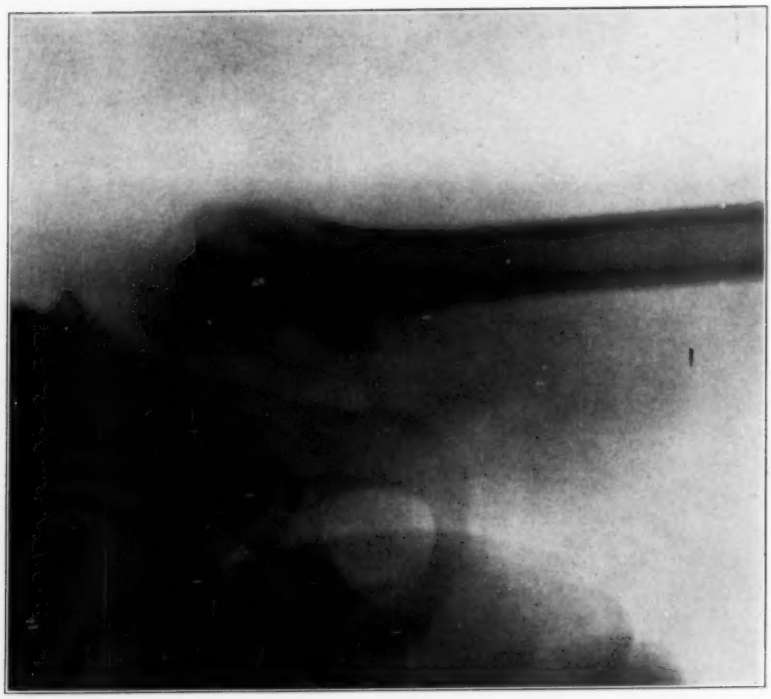

Fig. 3
Leg of dislocated hip hanging.

second, to replace the head in the acetabulum. I did not think the head slipped upward when weight was borne on the leg; nor did I think the head was bent forward. To determine this I took him at once to the radiographer and had films made with the boy standing, first on one leg and then on the other. These films show that the head does not ride up when full weight is borne on this leg; and they do show that the dense bone around the false socket is a lip or shelf of bone extending outwards a full half inch.

When these films were submitted to Dr. Adams he wrote on September 29, 1927: "The x-rays of the M. . . . boy have come and I have scrutinized them carefully. I agree with you that it is the best shelf I have ever seen which has formed at the upper margin of the socket. It seems to overlap the head in all positions by a good half and in some by two-thirds. We both realize that the head is a big mushroomed one, and I do not see how any operation or manipulation is going to help that boy. In his case, I certainly would not recommend the operation I spoke to you about, of taking out the rotation; the neck is too short. I have written this before Dr. Brackett's return, and have saved the x-rays for him to inspect, and he also has my record."

On October 18, 1927, Dr. Brackett wrote:—"Adams and I have talked it over together, and he has told me the result of his examination, and also his advice in regard to the case. I should certainly concur with him. I do not see what advantage one would have to operate on a case of this kind. The x-rays show a definite shelf, and of course, as we know, if we could only see that in the open, there is much more of an acetabulum made at this area than the x-ray shows, for the padding in by the cartilage in these new-formed joints at this age is rather an essential part of the process. Adams tells me that there is little or no up-push on the femur, and the boy is quite stable. One would not think of reaming out the acetabulum, for that would not give as good a joint as at present; and the other operation of putting down a shelf seems to me unnecessary, for there is already a shelf there, and this will increase with added use. I was very glad to see this, for to observe the development of these shelves in cases of this sort is most interesting. I have had two that I have been able to watch, which have developed the same condition; these, however, were both double. One of these I have been able to watch for quite a number of years, and the older the boy became the more firm his hips grew and the better became his gait."

CONCLUSIONS

1. There are some cases of congenital dislocation of the hip that are really congenital dislocations,—not merely shallow sockets and deformed heads and necks that are easily dislocated.

2. Dislocated hips gradually travel upward, little or much depending upon whether they are far forward or far backward. Those that are forward go up little more than the transverse diameter of the heads. Those at the back may go up as much as four and one-half inches.

3. False sockets, more or less deep, develop with a more or less secure rim, in this instance to the height of half an inch, sufficient to retain the dislocated head in its new position.

4. The range of motion gradually increases with use.

5. When considering Alexander Hugh Ferguson's operation of turning down a shelf from the outer table of the ilium, it may be well to wait long enough to determine if the operation is really necessary.

6. In considering the advisability of doing an operation to correct an assumed twist in the femoral neck, the length of the neck should first be determined. This is also a matter when considering the probability of the replaced head being retained in the acetabulum after it has been put there.

A NEW HYDROTHERAPY TUB

BY W. P. BLOUNT, M.D., MILWAUKEE, WISCONSIN AND MILDRED ELSON, MADISON, WISCONSIN

The advantages of hydrotherapy in the treatment of residual poliomyelitis have been well shown during the last few years.* Adequate facilities for underwater exercises are usually lacking, however. The common bathtub is too small to allow free movement of the limbs of any but the smallest children. Large circular tubs and pools have been filled with warm water and used to advantage in muscle training and in supervised swimming. But the expense of these tanks, coupled with the necessity for considerable floor space, has made them impractical in most cases.

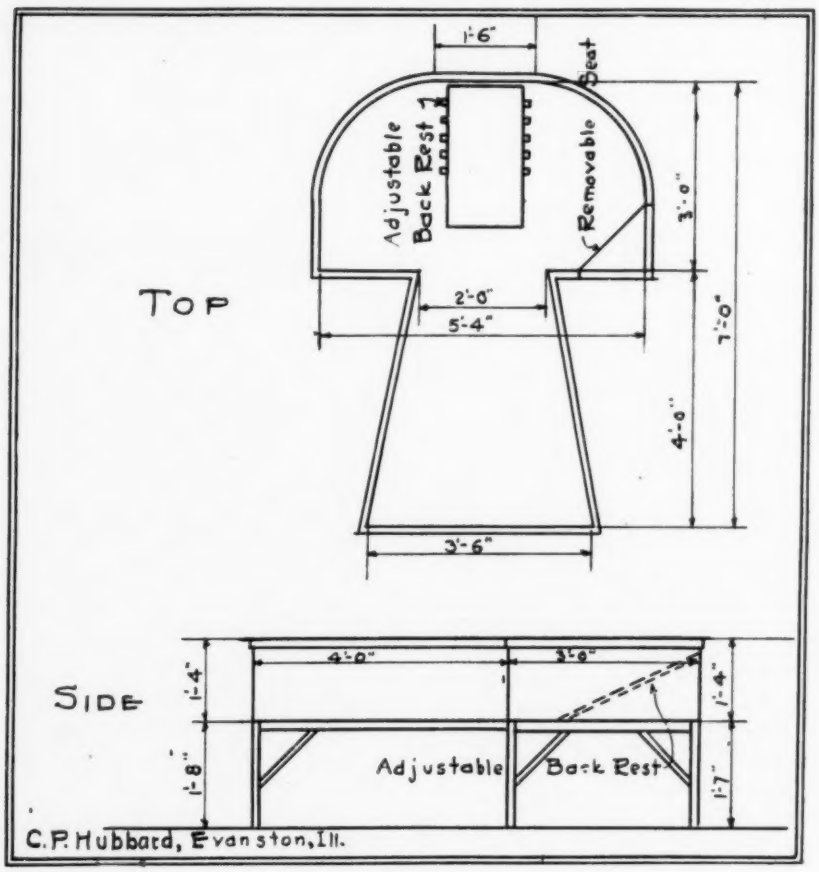

FIG. 1
A plan of the tub with dimensions

Through the kindness of the inventor, Mr. Carl Hubbard of Chicago, we offer the plans of a simple and effective tub which is in use at Madison, Wisconsin. It is made of sheet iron and mounted on legs which bring it to the proper height to avoid stooping on the part of the operator. It is of such size that the average man may be submerged and at the same time be permitted free abduction of all extremities. A minimum amount of water is required. The tub itself is not expensive, and may be set up in the ordinary home.

There are several advantages of the peculiar shape. Without being himself in the water, the physiotherapist accurately controls the exercises in all positions. By standing in the notch, he may support the extremities without the usual backstrain, especially in exercising the deltoids and glutaei. The water is deep enough for buoyancy in all cases, but shallow enough for safety. Helpless cases are supported sufficiently to allow control of the exercises by a single operator. Introducing patients and removing them is as simple as in the case of the ordinary bathtub. With larger tubs, the handling of patients is one of the difficult problems. When patients are ready to walk alone, a large pool is obviously of benefit for swimming and walking instruction. For the finer muscle training, the Hubbard unit is still preferable. Exercises may be graded as in table work.

In the treatment of subacute cases this tub is of particular value. The temperature of the water may be increased to stimulate circulation in the

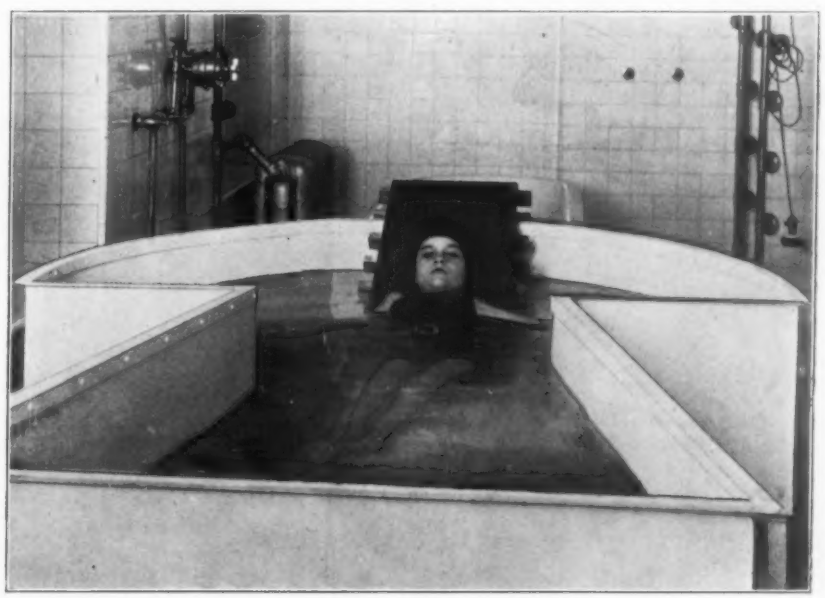

FIG. 2

The head is supported by the back rest.
The extremities are submerged for exercising.

relief of primary muscle soreness, and later in the mobilization of stiff joints. Floating exercises may be started earlier than table work with no harm to the patient. The danger of overwork is lessened when the gentle support of the water is substituted for the resistance of the table top. Later, the water offers a desirable resistance to the more rapid active movements, so that the power required increases geometrically as the patient is able to move more rapidly. At this stage it may be desirable to supplement tub work with other physiotherapeutic methods.

SUMMARY

Plans are shown for a tub to be used in the hydrotherapeutic treatment of subacute and chronic cases of poliomyelitis.

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FRACTURE OF THE SPINE OF THE TIBIA*

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NATURE OF THE INJURY

When a sudden excessive strain is put upon the anterior crucial ligament in a particular manner, it tears up the floor of the anterior intercondylic fossa from before backwards, taking with it the anterior cornu of the lateral meniscus, the tear extending laterally and posteriorly so as to involve quite a large mass of bone. This mass of bone, which consists of much more than the spine of the tibia, leaves beneath it a hole, the boundaries of which encroach not only on most of the floor of the anterior fossa, but also on a considerable part of one or both condylic surfaces. Sometimes the portion of detached bone includes the whole of the spine, but more often it affects the mesial three-quarters only, leaving the lateral tubercle intact; in the latter case the mesial condylic surface is the one solely encroached upon.

An investigation of the published cases, coupled with my own observations, leads to the conclusion that this is the usual type of fracture. Two other types have been described,—*viz.*, injury to the spine combined with a fracture of one condyle, and fracture of the lateral tubercle only; these will be referred to later.

REVIEW OF THE LITERATURE

1. Poncet first described this fracture in 1875. It was discovered after death in someone who had been killed instantly by a fall from a third story window. There was found "a tearing off of the spine of the tibia by the anterior crucial ligament; all the portion of bone which constitutes this eminence was torn off . . . In the place of the spine of the tibia there was a hole which looked as if it had been made with a punch."

2. Dittel, in the following year, had a similar case, occurring in a man who was being thrown out of a public-house. The knee filled with blood; this became septic following puncture; amputation was resorted to, and the patient died. At the postmortem, the anterior crucial ligament was found detached at its lower end, having torn with it an oval piece of the upper surface of the tibia.

3. These two cases and a third, also discovered postmortem, form the subject of an editorial note in the Medical Times and Gazette for

*Read before the British Orthopaedic Association, Bristol, October 21, 1927.

September 30, 1876, under the heading of "Separation of the Spine of the Tibia". "The third case occurred in the wards of University College Hospital in April, 1873 . . . A condition precisely similar to that described by Poncet was discovered . . . One point may be added, which, if the close proximity of the attachments of the external semilunar cartilage and the anterior crucial ligament be borne in mind, must almost certainly have occurred in the other two cases,—*viz.*, that the external semilunar cartilage went up with the anterior crucial ligament and the separated spine of the tibia . . ."*

4. Rickman Godlee described and figured this same case of the editor's in 1888. He said, "On opening the knee joint a loose piece of bone was found separated from the top of the tibia, with the anterior crucial ligament and the external semilunar cartilage attached to it". His drawing shows very clearly the hole in the top of the tibia from which it had been torn, and serves very well to illustrate the four cases to be described later.

5. In 1903, J. Hogarth Pringle met with the injury in the living subject. A man, A. L., aged thirty-six, received a severe blow on the outer aspect of the left knee joint on June 14. On June 26, the knee joint was opened (route not mentioned) "and it was at once seen that the anterior crucial ligament still attached to its bone insertion had been torn off the tibia and taken the spine with it; with a little trouble this was sutured and the wound closed". When last seen, September 3, 1905, "he said he had perfect confidence in the strength of the knee; it troubles him only a little at times when coming down stairs. There was the very slightest degree of abduction permitted when the joint was fully extended."

6. Sidney Lange, in 1908, mentioned two cases of fractured spine of tibia, naming them "crucial ligament fracture".

7. Robert Jones and S. Alwyn Smith followed with an important communication in 1913. They divide the cases into three groups:—

(1) Avulsion of the tibial spine or its internal (mesial) tubercle, due to a sudden excessive strain on the anterior crucial ligament. (See my first three cases, *P.B.R.*)

(2) Fracture of the external (lateral) tubercle of the spine, due to a sudden blow from the sharp intercondylar edge of the external condyle. (See my fifth case, *P.B.R.*)

(3) Injury to the spine combined with fracture of a tuberosity of the tibia. (See my fourth case, *P.B.R.*)

They give ten cases of the first type, four living cases and one dissecting-room case of the second, and two of the third. As regards this third type, the cases do not appear to differ in any way, so far as the spine is concerned, from those of the first, except that the additional fracture renders the prognosis worse. As regards the second type, which these

*The specimen of this case is in the Museum of University College Hospital, No. 10 B. 3., and owing to the courtesy of the Curator, Dr. W. G. Barnard, Mr. Roth was able to show it to the Members of the Association.

authors are the first to describe, it is observable that none of the five cases is very convincing and that there is no clear x-ray picture showing the external tubercle broken off. In fact, these cases alone, unsupported by others, would hardly justify us in accepting a separate classification.

A case of fracture of the external tubercle has however recently come under examination (See Case 5), and may serve, perhaps, to establish the occurrence of this injury beyond a doubt. It must be looked upon however as very rare.

Turning now to their sixteen cases as a whole, one regrets that the radiograms with but one or two exceptions have been poorly reproduced, and that the authors have relied in many cases on the anteroposterior view alone; to form a correct estimate of the amount of displacement, the lateral view is required. Most of their cases were seen for the first time months or years after the injury, and those operated on were after a period of fourteen weeks, seventeen weeks, sixteen weeks, and fifteen months respectively from the time of injury. No case of recent injury came under their care. As regards treatment, they advise, "If met with at once, the knee should be manipulated until full extension is secured. If there be no sign of laxity of the joint, due to injury to the crucials or other ligaments, the fixation need not exceed two months. Good function may be confidently expected, in the absence of a bone block, to full extension. When full extension is not possible and disability exists in addition, whether it be pain, stiffness or effusion, operation is to be recommended."

Some comments may be made on this advice. In the first place, when the injury is "met with at once" full extension cannot be secured by manipulation. Secondly, in cases "met with at once" the outstanding feature is the marked and painful distention of the knee joint with blood, with consequent loss of mobility; there is no laxity of the joint possible. This is a sign met with only very much later, and therefore its presence or absence cannot be used at this stage as a means of guiding us as to probable length of treatment.

Finally, if the anterior crucial ligament is tight in extension, as the authors describe earlier in their paper, forcibly extending the knee will still further separate the detached fragment from the tibia.

The operation advised by them is a vertical splitting of the patella—which route gives a very good view of the joint—the removal of most of the subpatellar pad of fat and then the removal of the displaced fragment of bone by cutting through these fibers of the anterior crucial ligament attached to it. This relieves the bone block, it is true, but removal of most of the pad of fat and leaving part or all of the anterior crucial ligament unattached seems a harmful proceeding, likely to be followed by weakness of the joint.

8. In 1916, Robert Jones gave a description of the mechanism of the injury, and as regards treatment advised as follows:—"If the knee can be fully extended the displaced fragment of bone being presumably pushed back somewhere between the condyles, the knee should be fixed in this

position for a long period to allow the torn structures to reunite". If the fragment blocks extension he advises its removal.

The suggestion that the bone should be "presumably pushed back somewhere" does not seem correct. If it is to be pushed anywhere it ought to be pushed *down*, since it has been torn *up*. The more it is pushed back, the farther will the anterior crucial ligament be separated from its point of attachment, the less likely will it be to unite with the tibia, and the weaker will the knee become subsequently.

9. In 1918, S. Alwyn Smith described a case of avulsion of the tibial spine of six months' standing. He removed the bony obstruction and sutured the anterior crucial ligament in position.

10. Ross, in 1919, published a case of fracture of intercondylar spine of tibia, "having seen the case four and one-half weeks after the injury". He treated it by active and passive movements, and nine months later there was complete restoration of flexion and almost complete restoration of extension. There was a sense of grating in the joint on motion.

11. S. Fosdick Jones, in 1920, reported a case, the end result being a very nearly perfect knee, after long immobilization. His paper is not available.

12. Kurlander, in 1921, had seen three cases in one thousand cases of fracture. He says the treatment should be entirely conservative and should give way to operative interference only after repeated attempts to get full extension have failed. The results of treatment are highly satisfactory. One case made "a complete recovery with normal function". (No details given.) His other two cases "passed from his observation". He thinks the posterior crucial ligament is usually the chief causative factor.

13. In the same year S. Alwyn Smith returns to this subject. After a description of the injury, he says that "in recent cases of avulsion of the tibial spine, despite the advice of Hogarth Pringle, I think it is advisable to try the effect of immobilization of the knee in the extended position for about ten weeks", etc. (But it must be remembered that he still has not met with a recent case.) In a separate paragraph he gives a full description of fracture of the external tubercle.

14. Blaisdell, in 1922, published an account of an experimental study into the mode of production of the fracture.

15. J. Warren Sever, in the same year, contributed a paper on "Fractures of the Tibial Spine combined with Fractures of the Tuberosities of the Tibia". One of his cases appears to be a true case of fracture of the tibial spine.

16. Stephens, in 1923, published a paper on the fracture, with note; of two cases. The first he saw only once, a few hours after the accidents the radiogram showed a fragment involving the entire spine of the tibia. The second case was seen ten months after the accident, with limitation of full extension; an operation was done and a mass in front removed. The writer is very optimistic, and assumes "that the ultimate result in all

cases is very satisfactory, as no unsuccessful cases have been reported". He says "Conservative treatment is usually successful in recent cases, and occasionally in old cases"; but he does not state on what data he bases his opinion.

17. Gilmore, in 1926, reported a case under his care in Iraq during 1924. He diagnosed it the day after the accident and lost no time in opening the knee joint and removing the fragment. Six months later patient could walk three miles a day without discomfort, and take part in cricket.

18. Wilson and Cochrane, in 1925, describe this fracture, mention the usual form it takes, quote Jones and Smith for the external tubercle fracture, state that the signs are considerable injury to knee, pain, disability, and swelling. The only physical sign on which a diagnosis may be based is locking of the joint on extension, and this may be absent. "The character of the jamming of the bones suggests an osseous block and it is distinct from the elastic type of jamming that is associated with a displaced or torn semilunar cartilage. Treatment aims at getting rid of the bony blocking, when present, and in trying to obtain union of the fragments by immobilization in plaster for six to eight weeks. Manipulation may be attempted under anaesthesia, the knee being flexed, and the leg rotated until full extension of the knee is possible." If this fails, the fragment should be removed through the split patellar route.

From a perusal of the foregoing, there can be no doubt that the accepted treatment of this injury at the present time is manipulation, followed by immobilization in as extended a position as possible. Only after many months is operation to be done, if at all. It may be noted, however, that those who advise this course have not met with a recent case.

I venture to suggest that there is a better treatment—immediate operation and exact replacement of the fragment in the top of the tibia. Four cases have come under my care, in all of which this has been done within a fortnight of injury. They are as follows:—

CASE REPORTS

CASE 1. John D., aged nineteen, was first seen on October 30, 1924. Five days previously, when playing football, he was charged over and his right knee badly damaged. He was carried home in great pain and sent up to the Miller Hospital by Dr. Solof to have a radiogram taken. This showed an extensive fracture involving the middle third of the top of the tibia, penetrating deeply beneath the base of the spine. In the lateral view it could be seen that a large piece of bone had been displaced upwards (Figs. 1 and 2). On admission the knee was semiflexed and tightly distended with fluid; all movements were objected to. On November 4, that is, ten days after the accident, the knee joint was explored through the vertically-split patellar route, it being noticed that the knee could not be extended beyond 150 degrees, even when the patient was under the anaesthetic. On opening the joint there was a gush of red blood. When this was swabbed away and the two halves of the patella widely separated, a large fragment of bone was seen lying in the intercondylar notch, attached above and posteriorly to the

FIG.1 FIG. 2

Fig. 1. Case 1. October 28, 1924. Three days after accident.

Fig. 2. Case 1. Lateral view.

anterior crucial ligament and externally to the anterior horn of the lateral meniscus. The fragment lay tilted round on itself, so that its lower raw surface, the base of the pyramid, was facing directly forwards, instead of directly downwards. The place from which it had been torn was represented by a deep hole in the upper surface of the tibia. Attempts to tilt the fragment back into place were entirely prevented by the lateral meniscus attached to it; so this was divided with a tenotome at a point one-quarter inch away from its attachment to the fragment, allowing the latter to be twisted round with forceps and put exactly in place in the top of the tibia while still attached to the anterior crucial ligament. The knee was straightened, full extension being now possible, and in that position there was no tendency for the fragment to shift its place; in fact, the condyles seemed to ram it home most effectively. So without suturing the fragment in any way the operation wound was closed and the limb put in a straight plaster case. Recovery was uneventful; on November 27 the plaster was split down, the stitches removed, and massage and gentle movements started. On December 16, a radiogram (unfortunately mislaid) showed that the fragment had fused in place with the rest of the tibia; on February 5, 1925, flexion was possible to an angle of sixty degrees, while extension was almost complete. On October 13, 1927, he was seen again, and reported that his knee never gave him the slightest trouble. Extension was complete; there was no unnatural mobility, and no grating on movement. The only sign of there having been an injury was that flexion was not possible farther than sixty degrees. He stands all day at his work and can run up and down stairs.

CASE 2. John J., aged seven, was knocked down by a motor car on March 6, 1925, and received an injury to the left knee for which he was sent up to the Miller Hospital by Dr. Doyle. A radiogram (Figs. 3 and 4) showed that a large portion of bone had been detached from the top of the tibia and was filling up the space between the femoral condyles and the tibia. When seen by me on March 12, six days after the accident, the knee joint was tightly distended, semiflexed, and all attempts at movement painful. He was admitted to hospital and on March 17, I explored his knee by the median patellar route. On removing masses of blood-clot, a fragment of bone was observed, detached from the top of the tibia. It included much more than the spine,

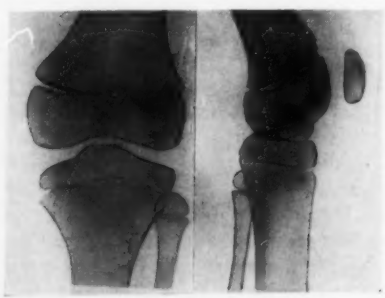

FIG. 3 FIG. 4

Fig. 3. Case 2. March 7, 1925. One day after accident.

Fig. 4. Case 2. Lateral view.

FIG. 5 FIG. 6

Fig. 5. Case 2. Sept. 17, 1925. Six months after operation.

Fig. 6. Case 2. Lateral view.

and was displaced upwards and tilted over sideways so that its underneath raw surface looked inwards. Attached to its upper aspect was the anterior crucial ligament and to its outer side the anterior horn of the lateral meniscus. In the top of the tibia was seen the deep jagged hole from which the fragment had been torn. Attempts to replace it were unsuccessful until the lateral meniscus was divided in front as in the first case; it then fitted back into the hole with perfect accuracy, and was held there with forceps while the knee was straightened. When the forceps were withdrawn it remained in place. The wound was closed and the limb put up on a back splint in full extension. On April 23, a radiogram showed there was no bony displacement and the patient was allowed to walk with crutches and without any splint. Although it eventually got quite well, the knee remained slightly swollen and hotter than the other for some time. This was probably due to the period of fixation having been too short. On September 15, he could flex the knee to ninety degrees and extend to 170, and could walk and run without a limp. A radiogram two days later (Figs. 5 and 6) showed the fragment united to the rest of the tibia. On December 3, he could extend all except the last five degrees and could flex to eighty degrees; the knee was sound and firm; there was no abnormal mobility. I was told he never complained of his knee at all, but he still could not kneel quite as well on that knee as on the other. When seen in June of this year the knee appeared normal except for very slight limitation of complete flexion.

Case 3. John S., aged eleven, was first seen on December 3, 1925. Three days previously, when doing an exercise in gymnastic class, he fell and injured his right knee. On examination, the knee joint was tightly distended with fluid, semiflexed, and no movement possible. The radiogram (Figs. 7 and 8) showed that a large fragment had been torn out of the top of the tibia and displaced upwards. In the anteroposterior view a line of fracture was seen, extending deeply beneath the base of the spine. Patient was admitted, and operation performed on December 7, that is, eight days after the injury. Through the median patellar route the blood was let out, the clot removed from the hole in the tibia, and the fragment observed lying displaced to the outer side. The lateral meniscus which was attached to it, was divided with a tenotome in anterior third, allowing the fragment to sink perfectly into place in the hole in the tibia. The knee was straightened, the wound sutured, and plaster applied. In this case the fragment was very large, at least three-quarters of an inch square, like a box-lid, with the whole of the anterior crucial ligament attached at its center.

On January 7, 1926, the plaster was removed and a radiogram taken (Figs. 9 and 10); as this showed that the fragment was in position the plaster was reapplied. A fortnight later this was finally removed, and the patient encouraged to use the limb. On February 18, he could flex the knee to eighty degrees and walk with only a very slight limp.

Fig. 7

Fig. 8

Fig. 7. Case 3. December 3, 1925. One day after accident.

Fig. 8. Case 3. Lateral view.

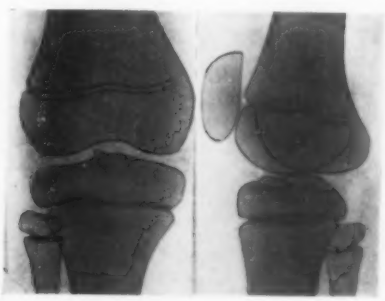

Fig. 9

Fig. 10

Fig. 9. Case 3. January 7, 1926. Four weeks after operation.

Fig. 10. Case 3. Lateral view.

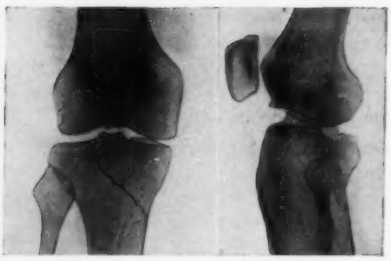

FIG. 11 FIG. 12

Fig. 11. Case 4. October 13, 1926.
Fig. 12. Case 4. Lateral view.

When seen in June of this year, there was no limp, and the bone appeared normal except for very slight limitation of flexion.

CASE 4. Mrs. A.D., aged fifty-eight, was hanging the washing on a line on October 12, 1926, when the ladder on which she was standing collapsed, and she fell a distance of three feet, landing very hard on the right heel. She was sent up by Dr. Doyle, the same day, and admitted to hospital. The knee joint was very much enlarged, tightly distended with fluid, and very tender. A radiogram taken next day (Figs. 11 and 12) showed:

1. A fracture involving the whole of the mesial tuberosity of the upper end of the tibia,
2. A fracture of the whole of the spine of the tibia, with displacement of the fractured portion upwards,
3. The presence of a small fragment of bone free in the joint.

Operation was performed a fortnight later. On exploring the joint, the loose fragment was found and removed, the mass of bone involving the spine was returned to its proper place, by the now familiar method of dividing the attachment to it of the lateral meniscus, and the limb put up in plaster in full extension.

When examined on September 22, 1927, the patient, a very nervous subject, "walks well with one stick, can extend knee completely, can flex knee to eighty degrees and has a perfectly stable joint without any abnormal mobility. The range of flexion is still improving, and the power of the limb increasing." The radiogram shows that the spine has fused in place.

FRACTURE OF THE EXTERNAL TUBERCLE

CASE 5. Mr. Roger R. T., aged thirty-three, consulted me in March, 1927, about a loose body in his right knee. Radiograms taken for me by Dr. Salmond showed the loose body, but also revealed that he had at some time or other sustained a fracture of the lateral tubercle of the spine of the left tibia (Fig. 13).

On being questioned he then informed me that he had injured his left knee in December, 1910, playing "soccer". It was a severe injury; his left knee was forced inwards violently from the side while it was fully extended; he went on playing, but the knee "wobbled all over the place"; it "did not seem to be tight," and so he had to stop. In an hour or so it had become very painful. Ever since, the knee has been weak and unsteady.

In the radiogram, anteroposterior view, the lateral tubercle is entirely missing; it has been fractured off and apparently absorbed.

This is a case of the type first described by Jones and Smith, and is I believe, exceedingly rare.

REMARKS ON DIAGNOSIS AND TREATMENT OF RECENT CASES

Though the actual diagnosis of the lesion depends on the radiogram, there are several points about these cases which seem to render the diagnosis of fractured spine very likely.

1. There is a history of a *very severe injury;* the patient is unable to stand or walk after it has happened, and has to be carried home.

2. There is a *very rapid distention* of the joint cavity, so that the patient tells you that in an hour the knee became swollen, hard, and shiny.

This distention is due to blood, which pours out of the torn-open bone until the pressure in the joint equals that of the arterial circulation.

3. There is *marked limitation of movement*, especially extension, and the knee is semiflexed. When seen a few days after the accident, it is impossible to move the knee at all, because it is so swollen and because movement is so painful; the patient simply will not let you move it.

4. Because of this limitation of movement, *manipulation* of the knee without an anaesthetic is *impossible.*

Comparing these characteristics with those of ruptured or displaced meniscus, we are at once struck with the fact that in the latter condition the lesion is not so severe; after a few minutes the patient is able to get up and limp off; very often the displacement rights itself, or the patient can work the displaced meniscus out of its painful position.

Any swelling that occurs is never really noticed till next day, and the joint does not become tightly distended; for the distention in this case is with synovial fluid, which is secreted to a sufficient degree to bathe the damaged parts and no more.

There is limitation of movement; for a few minutes perhaps, the knee is locked; but this soon passes off, and though complete extension is prevented, flexion is not interfered with at all. Finally, manipulation by a surgeon can be carried out immediately, with good hope of success.

I have not found the suggestion of Wilson and Cochrane as to the character of the jamming to be of value in diagnosis. If the case be recent, no movement is allowed by the patient; if old, the blocking from a bony mass covered with cartilage is indistinguishable from that due to a displaced meniscus.

The treatment of recent cases should be operative. Three of my patients have made a recovery so complete that their knees never give them the slightest trouble; the fourth, though complicated by comminution and by a fracture into the joint of the mesial tuberosity, is slowly recovering its function. On the other hand I have seen quite a number of cases of fracture of the tibial spine where no operation has been performed, and all had a serious permanent disability. In several instances I have operated

FIG. 13

Case 5. Fracture of external tubercle of spine of tibia.

to remove a bony block and been successful, but the knee has still remained unsound. One case, owing to a misunderstanding, was treated by his doctor at home without operation. I was surprised to find some months afterward that the knee had almost completely recovered; but only a few weeks ago he turned up at the hospital, complaining that his knee had suddenly started slipping about and letting him down, and I had to order a permanent support. In several other unoperated cases, a permanent support has been the only possible treatment.

From my experience at operation, it is clear that what prevents the fragment from being replaced is the lateral meniscus. Until this is divided no replacement is possible. No amount of manipulation can get over this difficulty. I therefore submit that an operation consisting of the following steps should be done at the earliest opportunity:

1. Application of Martin's bandage as a tourniquet.
2. Vertical splitting of quadriceps, patella, and ligamentum patellae.
3. Complete flexion of knee, with wide retraction and eversion of the two halves of the patella.
4. Swabbing out of all blood and blood-clot.
5. Division of anterior horn of lateral meniscus.
6. Replacement of the bony fragment in its hole.
7. Complete extension of knee while fragment is held in place with forceps.
8. Removal of forceps, and sewing up of wound.
9. Application of plaster in full extension.
10. After-treatment: Plaster to be removed at the end of a month, and active movements and massage started.

If this method be followed, I believe that a very great advance will be made in perfecting the treatment of this injury.

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RELAXED MOTION IN FRACTURE TREATMENT

A Preliminary Report

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Massage and mobilization in the treatment of fractures has been ably described by Lucas-Championnière[1] and more recently has been modernized and given fresh impetus by the excellent contribution of J. B. Mennell[2]. It is a method deserving special consideration by anyone interested in the treatment of fractures because it has perhaps a wider field of application than any other single method.

Hey-Groves[3] discusses fracture treatment under three headings:

1. Massage and mobilization.
2. Extension methods.
3. Operative methods.

He gives massage and mobilization first place because, he says, in its fundamental principles it ought to find a place in every fracture case without exception, in conjunction with other methods. Its simplicity and the relatively large number of cases in which it should be chosen as the sole or chief method of meeting the problem of rapidly restoring function, gives it further claim to our consideration.

As pointed out elsewhere, there has been some misconception of the actual technique of applying the method, due to the use of the term "massage" in connection with it. The massage used is not the application of pressure or force of any kind, but a gentle rhythmic stroking, which, in order to be effective, must be entirely soothing and agreeable to the patient. The purpose of this gentle stroking or effleurage is to relieve muscle spasm, and, when properly applied, will be found an extremely effective measure in cases where early mobilization is indicated. The relief of muscle spasm has several clinical advantages, inversely proportional to the length of time which has elapsed following the injury. If accomplished before the swelling has become pronounced, it will largely tend to prevent it by lessening the flow of blood to the part and by improving the return circulation. At this time it will in some cases enable one to accomplish minor adjustments of the fragments painlessly and without an anaesthetic. If marked swelling has occurred, the massage may be used for its control and reduction, and also for the relief of pain. Later it permits of motion in the neighboring joints without displacing the fragments. In case the fracture involves a joint, the massage makes early painless motion possible without the untoward effect of injuring newly formed vascular structures and causing more hemorrhage, with the resultant increase of obstructing callus about the joint.

FIG. 1

FIG. 2

Case 1. On admission.

FIG. 3

FIG. 4

Case 1. Taken one day after admission, with forearm extended during treatment.

FIG. 5

FIG. 6

FIG. 7

FIG. 8

FIG. 9

FIG. 10

Case 1. Figs. 5, 6, and 7, show method of supporting forearm during massage and gradual extension. Figs. 8 and 9 show elbow elevated for return to acute flexion by the action of gravity. Fig. 10 shows adhesive band for maintaining acute flexion. Note expression of patient, showing absence of pain or fear. These pictures were taken during treatment one day after injury.

FIG. 11

FIG. 12

Case 2. On admission.

FIG. 13

FIG. 14

Case 2. On discharge.

The type of motion used in the early treatment of our cases, before there is any appreciable fixation of the fragments by callus, is essentially that caused by the action of gravity on the relaxed extremity.

In the elbow fractures presented in this paper, the actual procedure was as follows: As soon as the x-rays had disclosed the exact nature of the fracture, the patient was placed in a recumbent position, with the elbow supported on a pillow, and massage started at about the level of the shoulder joint. Beginning the massage at some distance from the fracture site is more soothing to the patient and is more effective in relieving the swelling when started at its proximal limit. In the course of about twenty minutes the arm and forearm were gradually included in the rhythmic stroking. At this time a sufficient amount of gas-oxygen was administered to permit gentle manipulation, consisting of extension with moderate traction, followed by acute flexion of the joint. This position was maintained by a broad band of adhesive tape about the arm and forearm, after making certain that the circulation was not impaired. The preliminary massage was used to reduce the engorgement of the lymph spaces and make

FIG. 15

FIG. 16

Case 2. Showing degree of motion in flexion and extension on discharge.

FIG. 17 FIG. 18

Case 3. On admission. Note separation and rotation of capitulum of humerus.

FIG. 19 FIG. 20

Case 3. On discharge. This case shows effect of early motion on minor fragments which are difficult to control otherwise.

FIG. 21

FIG. 22

Case 3. Showing degree of motion at time of discharge.

FIG. 23

FIG. 24

Case 4. On admission.

FIG. 25 FIG. 26

Case 4. On discharge.

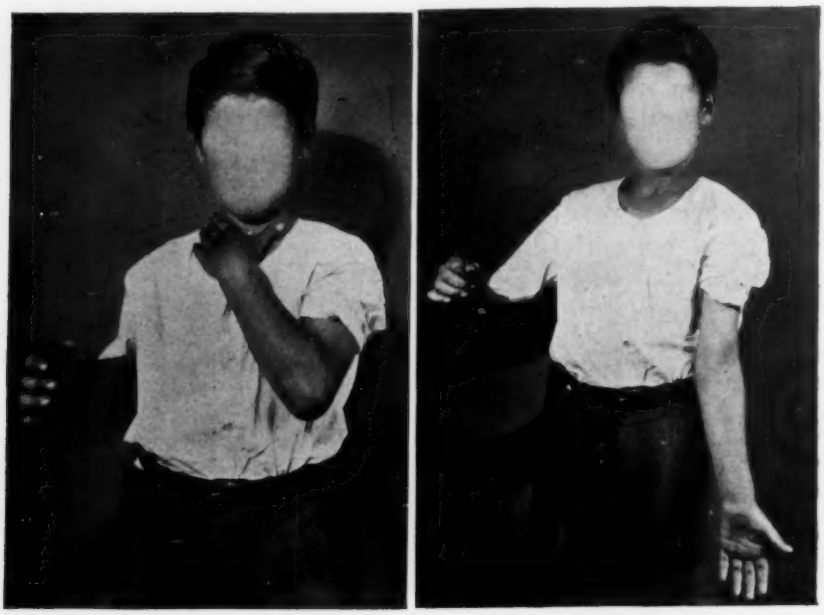

FIG. 27 FIG. 28

Case 4. Showing degree of motion on discharge.

FIG. 29

FIG. 30

Case 5. On admission.

FIG. 31

FIG. 32

Case 5. On discharge.

FIG. 33

FIG. 34

Case 5. Showing degree of motion on discharge.

FIG. 35

FIG. 36

Case 6. On admission.

FIG. 37

FIG. 38

Case 6. On discharge.

FIG. 39

FIG. 40

Case 6. Showing degree of motion on discharge.

FIG. 41
Case 7. On admission.

FIG. 42
Case 7. On discharge.

FIG. 43
Case 7. Showing position for relaxed circumduction of shoulder.

FIG. 44
Case 7. Shows arm relaxed, swinging in circumduction.

possible more acute flexion without obstructing the circulation. The patient was then placed in bed with the elbow elevated on pillows and the circulation noted at intervals for the first few hours.

On the day following the injury and each succeeding day thereafter, until all sensitiveness had disappeared, relaxed motion was obtained as follows: The patient was placed in a sitting position with the elbow supported. The adhesive was removed and the massage applied as previously described, except that the forearm while lightly supported was gradually allowed to extend. Motion in extension was stopped at the first evidence of discomfort on the part of the patient. Then by elevating the elbow the forearm was returned to its original position of flexion entirely by the action of gravity. It may be of interest to note that in our cases the degree of motion, which for the first few days was almost normal, gradually became less up to the time when sensitiveness disappeared. This usually occurred in from fifteen to twenty days, after which active motion was substituted for relaxed

FIG. 45 FIG. 46

Case 7. Showing degree of motion on discharge.

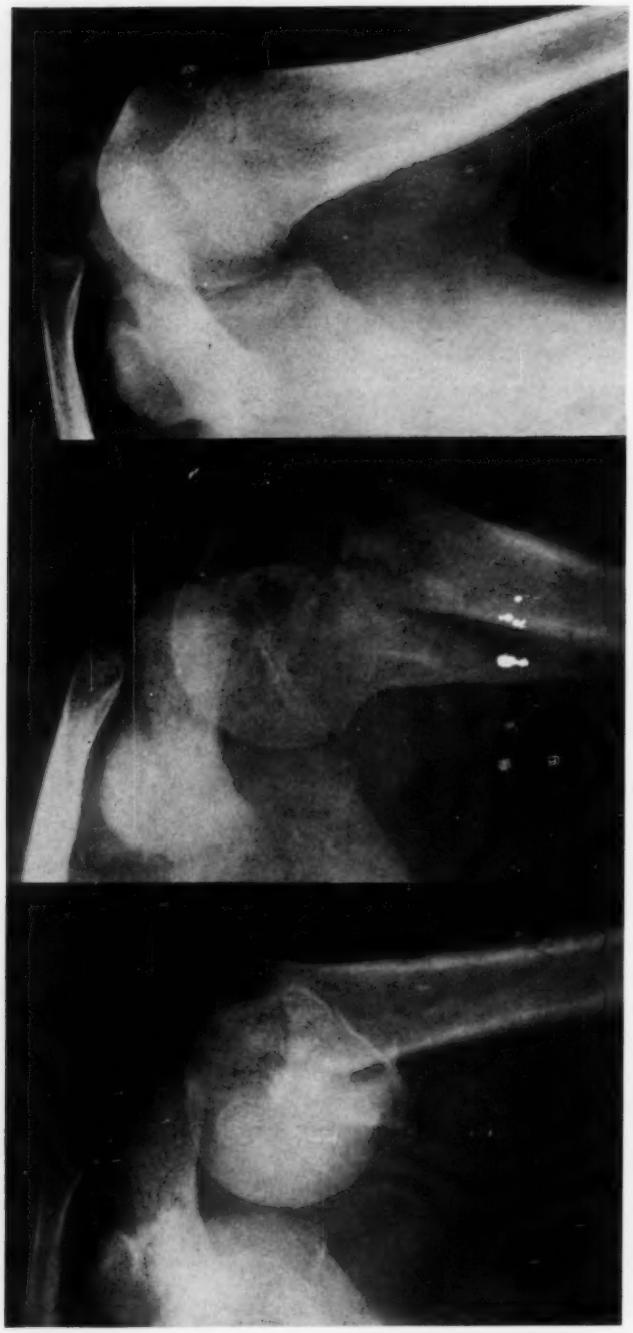

FIG. 47
Case 8. On admission.

FIG. 48
Case 8. Intermediate stage of repair.

FIG. 49
Case 8. On discharge.

FIG. 50 FIG. 51 FIG. 52

Case 8. Showing degree of motion on discharge.

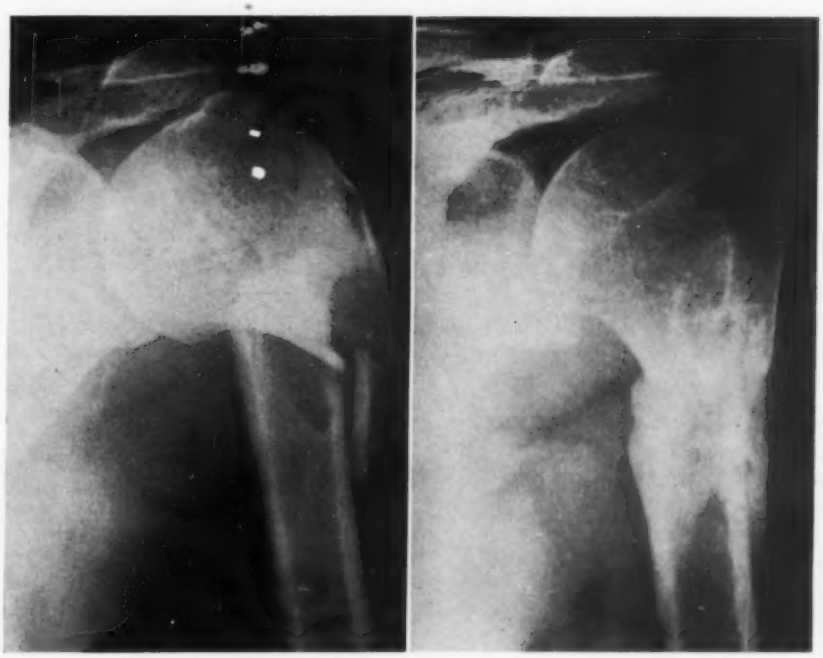

FIG. 53

Case 9. On admission.

FIG. 54

Case 9. On discharge.

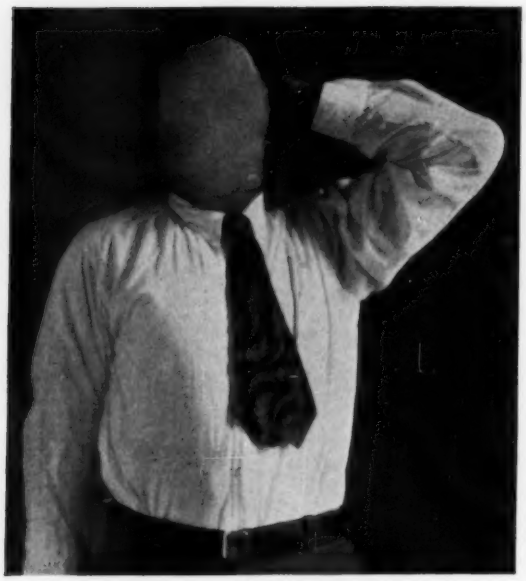

FIG. 55
Case 9. On discharge.

motion, and special care was directed to exercise of the triceps. All the exercises in extension were done with the hand supinated, since it was found there was a tendency to deformity with loss of the carrying angle if the exercises were done with the hand pronated.

In the original manipulation of these fractures, no special effort was made to control the minor fragments, and it is our belief that the wide range of motion in the first few days, before there is definite organization of the hemorrhage, has a distinct tendency to replace these fragments into a relatively normal position.

The shoulder cases shown were treated with massage for the pain and swelling and after the first two or three days, during which the arm was supported with a handerchief sling and circular bandage, relaxed circumduction was carried out daily. For this procedure the patient bends forward while standing and rests the forearm of the unaffected side on a table for partial support. Then, following massage for relaxation of the affected shoulder and arm, the patient's body is raised and lowered on that side by flexing and extending the knee on the same side. This causes the affected arm to swing in circumduction without muscular effort of the part. The active motion which is later substituted is carried out in the same position. The shoulder cases which showed marked over-riding of the fragments were put up in Jones' humeral splints with skin traction until this was overcome. The accompanying pictures, taken on admission and discharge, illustrate some of the cases in which we have used relaxed motion.

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A REVIEW OF END RESULTS OF THE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP

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The following report is preliminary to some further investigation of cases of congenital dislocation of the hip, which it is hoped will be of more value in determining how we may improve our methods of treatment. In this study we may draw a few conclusions, yet not decisive, in regard to the type of treatment which has given the best results. I hope that a continuation of this work may show us whether the present methods in common use are satisfactory, and if there is not some other condition present rather than a mere mechanical dislocation of the joint.

The cases embodied here were all treated as indoor patients at the Hospital for the Ruptured and Crippled during the twenty-year period from 1891 to 1910. It must be borne in mind that the records in those days were not as detailed as we are accustomed to have now, and also that it has been impossible in many cases to find complete records on individual cases. We must accept the word of the surgeons of that time, especially in the cases that have not been reached in the follow-up. The methods and types of operation used then were in many instances the same as employed at the present time. Naturally, in the open operations, we all feel that the technique has been greatly altered since that period.

We are all familiar with the moving population of New York and realize the great handicap which it imposes on a study of this character. Letters were sent out to all of the patients, and in many cases several letters to the same or different addresses obtained from the histories. This was kept up until the patients answered by letter, returned for examination, or were reported "not found" by the Post Office.

The results of the survey are:

7 patients returned for examination and x-ray.
3 patients died during or after treatment.
4 patients reported by letter.
171 patients could not be located but some of these had follow-up notes in their histories.

This makes a total of 185 patients for the twenty years.

The following table gives the general statistics for each decade separately and for the entire period.

1891–1900	1891–1910
48 patients—37 or 76 per cent. girls	185 patients—145 or 79 per cent. girls
11 or 23 per cent. boys	40 or 21 per cent. boys
55 hips— 7 bilateral	240 hips—55 bilateral
10 left	55 left
7 right	46 right
24 not designated	29 not designated
Age—Not noted in 30	Age on admission not noted in 47 patients.
18 patients from three to thirteen years.	138 patients from two and one-half to fourteen years.
Average—seven years	Average—six years and ten months.

1901–1910

137 patients—108 or 79 per cent. girls
29 or 21 per cent. boys
185 hips—48 bilateral
45 left
39 right
5 not designated
Age—Not noted in 17
120 patients from two and one-half to fourteen years
Average—six years and nine months

It is seen that there were almost three times as many patients admitted in the second decade as in the first. In the entire series there were about three times as many girls as boys. Nearly one-third of the patients had both hips involved and in the unilateral cases the left was slightly more frequently affected than the right. The average age on admission was three months lower in the second decade. It might be mentioned that there were two adults who have been omitted from this group as they were only observed and treated palliatively for pain.

In only thirty-three patients is there a record of the age when walking was begun and the average was twenty-three months, indicating that the affection presumably delayed this time by many months over the average for normal children.

The amount of shortening was listed in seventy of the 130 unilateral cases. It varied from one-quarter to three inches with an average of one and one-quarter inches.

In the first decade there were no notes of the type of dislocation, but in sixty-five hips during the second period they were as follows:

45 "Posterior"	3 "Outward"
15 "Anterior"	2 "Upward"

Among the 240 hips there were eighteen that did not have any attempt at reduction, as they were not deemed suitable because of age or complications, or because treatment was refused by the parents.

In several cases it has been impossible to find notes other than those of the operation, especially in the first half of the period, where this was the case in thirty-three of the fifty-five cases.

Preliminary plaster spicas were applied in four cases and preliminary traction was used in thirty but, as may be seen later in the tables, this seemed to have very little bearing on the success of the reduction.

It is interesting to learn that in the earliest part of this period the reductions were attempted most often by open operation. This was probably due to the example set by Hoffa, who is recorded as having done the first case at the Hospital which was on September 28, 1891. In passing, it may be mentioned that this was the only case in the entire series on which traction was used along with a plaster spica following operation. Later the work of Lorenz, particularly at the time of his visit to New York in 1902, seemed to cause a definite change, as we see that from then on most cases were attempted by closed manipulation. The first closed reduction was attempted by Gibney on October 28, 1892, tenotomy of the adductors being done at the same time.

From 1891 to 1900 there were forty-two open operations, thirty-seven of these being primary, and five following unsuccessful closed manipulations. From 1901 to 1910 there were only three primary and six secondary open operations. In this total of fifty-one open operations, the usual procedure was to deepen the acetabulum and replace the head, but in five cases the following operations were done.

1 Case—A marble was inserted in the acetabulum. The wound became infected and the marble was removed after four months. The partially necrotic head was placed in the acetabulum. At the time of discharge there was considerable shortening and ankylosis.

1 Case—A silver wire was placed around the neck to hold the head in place.

3 Cases—The head was removed. In two of these the neck was placed in the acetabulum and in the third case a new acetabulum was prepared.

The three cases previously listed as having died, included one of bilateral dislocation, which had five attempts at closed reduction on each hip and was discharged unimproved in 1906. A letter received in 1926 stated that the patient died of pneumonia in 1918. There was one case in 1899 that was successfully reduced by closed manipulation, and the patient died suddenly during the application of the plaster while she was still under nitrous oxide anaesthesia. The third case was a real accident and was due to a rupture of the femoral artery. This girl was twelve and one-half years old when admitted in 1902. Preliminary traction was followed by a rather prolonged attempt at closed reduction which failed. A second attempt was made three weeks later and the head was reduced. However, the patient went into shock and developed a large hematoma in the thigh and hip region. After six days a hip joint amputation was done but the patient died.

The following general tabulation shows the results in the 240 cases in some detail.

GENERAL TABULATION

18 No treatment.
1 Preliminary tenotomy, T. F. F.—1 closed; reduced; discharged in PPS.
1 Preliminary traction—1 open; discharged unreduced.
1 Preliminary traction—1 closed; reduced; discharged cured.
4 Preliminary traction—1 closed; reduced; discharged in PPS. (1 to contagion).
2 Preliminary traction—1 closed; reduced; discharged unreduced.
4 Preliminary traction—1 closed; failed; discharged unreduced (1 sciatic paralysis).
2 Preliminary traction—2 closed; failed; discharged unreduced (1 fractured neck).
1 Preliminary traction—1 closed; reduced; died (rupture femoral artery).
3 Preliminary traction—2 closed; reduced; discharged in PPS. (1 unreduced after thirty-two months) (1 unreduced after twenty-one years).
2 Preliminary traction—2 closed; reduced; discharged unreduced.
1 Preliminary traction—2 closed; tenotomy T.F.F.; discharged in PPS.
1 Preliminary traction—3 closed; reduced; discharged in PPS.
1 Preliminary traction—3 closed; discharged unreduced.
3 Preliminary traction—4 closed; reduced; (1 unreduced after 3 years) (1 reduced (?) with 1 inch shortening).
2 Preliminary traction—5 closed; discharged in PPS. (2 unreduced after twenty-one years).
1 Preliminary PPS.—1 closed; failed; discharged unreduced.
1 Preliminary PPS.—2 closed; failed; discharged unreduced.
2 Preliminary PPS.—2 closed; reduced; discharged in PPS. (8 months).
21 Open operation—reduced; discharged in PPS. (2 unreduced after 10 years) (1 unreduced after 20 years).
1 Open operation—Marble; infected; discharged with shortening and ankylosis.
4 Open operation—Tenotomy Add.; discharged in PPS. (1 unreduced, ankylosis after 28 years).
1 Open operation—Silver wire; reduced; discharged in PPS.
3 Open operation—Head removed; reduced; discharged in PPS.
4 Open operation—Discharged unreduced.
2 Open operation—1 closed; reduced; discharged in PPS.
2 Open operation—Osteotomy—1 discharged in PPS. 1 discharged unreduced.
1 Open operation—Reduced; discharged ankylosed.
1 Closed—Reduced; died under anaesthesia.
9 Closed—Reduced; discharged cured (6-18 months) (1 unreduced after 18 months).
36 Closed—Reduced; discharged in PPS. (3 to contagion).
6 Closed—Reduced; discharged in PPS. Later unreduced (2 after 13 months) (1 after 19 months) (2 after 21 months) (1 after 25 years).

11 Closed—Reduced; discharged unreduced (2 to contagion) (1 complicated by TBC spine).
14 Closed—Failed; discharged unreduced (1 fracture, femur).
1 Closed—Tenotomy Add.; reduced; discharged in PPS.
4 Closed—Open operation; discharged unreduced (1 after 4 months) (1 after 24 months).
1 Closed—Open operation; osteotomy for twisted neck; discharged ankylosed.
2 Closed—Open operation; discharged in PPS.
3, 2 Closed—Reduced; discharged cured (12—15 months).
13, 2 Closed—Reduced; discharged in PPS. (1 unreduced after 22 years).
3, 2 Closed—Reduced; discharged in PPS. (to contagion).
9, 2 Closed—Reduced; discharged unreduced.
7, 2 Closed—Failed; discharged unreduced (2 fractures, femur).
2, 2 Closed—Tenotomy Add.; discharged unreduced.
2, 2 Closed—Open operation; discharged unreduced (1 ankylosed with 1 inch shortening).
1, 2 Closed—Open operation; infection; reduced and ankylosed.
1, 3 Closed—Discharged cured (Unreduced after 10 years).
5, 3 Closed—Discharged in PPS.
10, 3 Closed—Discharged unreduced.
1, 3 Closed—Tenotomy T. F. F.; discharged in PPS.
1, 4 Closed—Open operation; 4 closed; discharged unreduced.
3, 5 Closed—Discharged cured (2 unreduced after 3½ years).
3, 5 Closed—Discharged unreduced.
1, 6 Closed—Discharged unreduced.

From the above table we are able to get the following statistical facts.

28 Hips treated with preliminary traction:
1 followed by open operation—discharged unreduced.
27 followed by closed operation (1 to 5 attempts).
2 discharged reduced.
6 discharged in plaster.
19 discharged unreduced—1 paralysis of sciatic nerve.
1 fracture of neck of femur.
1 rupture of femoral artery.

1 Hip—Preliminary tenotomy of tensor fascia femoris—
Followed by open operation—discharged in plaster.

4 Hips—Preliminary plaster spica—
Followed by 1 or 2 closed operations.
2 discharged in plaster.
2 discharged unreduced.

39 Primary open operations—
2 discharged reduced, but ankylosed.
28 discharged in plaster.
3 discharged in plaster—later found unreduced.

5 discharged unreduced.
1 discharged unreduced and ankylosed.
12 Secondary open operations—
2 discharged reduced, but ankylosed.
2 discharged in plaster.
7 discharged unreduced.
1 discharged unreduced and ankylosed.
51 Total Open Operations—
4 discharged reduced, but ankylosed.
30 discharged in plaster.
3 discharged in plaster—later found unreduced.
12 discharged unreduced.
2 discharged unreduced and ankylosed.
85 1 Closed operation—
1 died under anaesthesia.
9 discharged reduced (1 with ankylosis).
39 discharged in plaster.
36 discharged unreduced (1 with fracture of femur).
65 2 to 6 Closed operations—
6 discharged reduced (2 with ankylosis).
21 discharged in plaster.
38 discharged unreduced (2 with fracture of femur).
171 Total Closed Operation Cases—
(This includes the two groups immediately preceding and those which had preliminary traction or plaster.)
2 died.
14 discharged reduced.
6 discharged reduced. Later found unreduced.
70 discharged in plaster.
9 discharged in plaster. Later found unreduced.
70 discharged unreduced.
222 Total Hips Treated—
2 died.
14 discharged reduced (Last note 6 to 18 months after discharge).
4 discharged reduced but ankylosed.
6 discharged reduced. Later found unreduced.
100 discharged in plaster.
12 discharged in plaster. Later found unreduced.
82 discharged unreduced.
2 discharged unreduced and ankylosed.

In figuring percentages we find the following:

1 per cent. died during treatment.
1 per cent. ankylosed with head of femur not in acetabulum.
45 per cent. discharged in plaster and could not be followed.
45 per cent. discharged unreduced or found so later.
8 per cent. reduced, including the few that were ankylosed.

If the 100 cases discharged in plaster and the two deaths are omitted we have 120 hips with 85 per cent. unreduced and 15 per cent. reduced. Of the 100 in plaster, twelve or twelve per cent. were later found unreduced and none reported reduced. From this we might infer that the percentage of cures may be even lower than fifteen. Included in the 102 hips or 85 per cent. unreduced are six which were originally discharged as reduced, but on recent examination were found to be again out of place. Here again is a possibility of lowering the percentage of cures if all that were sent out reduced could be seen at the present time.

The percentages given are practically identical for the group treated by open operation and the group treated by closed manipulation. The total of twenty-four cases discharged reduced shows briefly:

4 ankylosed after open operation.
6 found to be later unreduced.
14 still reduced 6 to 18 months after treatment was ended.

The complications encountered were—

1 vertebral tuberculosis.
1 cerebral deficiency with spastic paralysis.
1 fragilitas ossium. This case strangely did not receive a fracture during manipulation but had two while in the Hospital and four during the next year as reported by letter.

The accidental complications in this series were—

1 death during anaesthesia.
1 rupture of femoral artery.
1 paralysis of sciatic nerve.
4 fractures of femur.

Osteotomy was performed in 8 cases.

7 subtrochanteric—3 for adduction.
4 for anterior rotation of head.
1 supracondylar —for anterior rotation of head.

On December 15, 1902, Lorenz and Müeller held a demonstration clinic at the Hospital for the Ruptured and Crippled which was reported by Ely and Ashley in "The Medical News" December 20, 1902. It is regrettable that these patients cannot be located at the present time, but in each case there are enough subsequent notes to convince us that all three later turned out to be unreduced. The next day a similar clinic was held at the old Polyclinic Hospital and a bilateral case reduced at that time also proved to be a later failure. On December 19 a third demonstration was given at the Vanderbilt Clinic and the case reduced is one of the seven that I was able to get back for examination and x-ray and it likewise is unreduced. It might be mentioned that all of these cases were carefully selected as many histories show that patients were examined and refused for demonstration purposes.

The following short resumés are of the above mentioned patients.

M. S., female, age six years. Left hip dislocated. Two inches of shortening. Closed reduction by Lorenz at the Hospital for the Ruptured and Crippled on December

15, 1902. Six months later was noted by Lorenz as not in the acetabulum. Two years and eight months after operation was still unreduced.

M. D., female, age seven years. Left hip dislocated. Three-fourths inch shortening. Started walking at fifteen months. Closed reduction by Lorenz at the Hospital for the Ruptured and Crippled on December 15, 1902. Last note, five and one-half years later (May 19, 1908) said head was anterior and there was one and one-fourth inches shortening.

H. K., female, age nine years. Left hip dislocated. Started walking at eighteen months. Closed reduction by Müeller at the Hospital for the Ruptured and Crippled on December 15, 1902. Ten months later patient was discharged and hip was said to be in place, but eighteen months after operation it was not in place.

K. H., female, age six years. Bilateral dislocation. Both hips were reduced by closed operation at Polyclinic Hospital by Lorenz and Müeller on December 16, 1902. Eighteen months later both heads were anterior and the posture more erect but gait unimproved.

J. S., male, age six years. Left hip dislocated posteriorly. Closed reduction by Lorenz at Vanderbilt Clinic on December 19, 1902. Discharged in plaster after nine and one-half months. Examined on May 19, 1926, seen among the seven cases with x-ray.

In the following cases we have been able to get letters or some fairly recent report of the end results.

E. P., female, age seven years. Admitted January 4, 1910. Left hip dislocated. One and one-half inches of shortening. Had three closed manipulations. Discharged in plaster spica after ten months with x-ray showing head of femur in acetabulum. Six years later (November 14, 1916) examination showed left hip dislocated. There was thickening of the upper third of the femur thought to be a periosteal sarcoma.

C. S., female, age twelve years. Admitted December 11, 1902. Right hip dislocated. Two and three-fourths inches shortening. Had two closed attempts. Discharged unreduced. June 1, 1926, letter saying that she is a widow with four children and supports them by canvassing. Walks eighteen or twenty miles a day. Says "limb" never bothers but at times her "knee" does.

S. F., male, age three years. Admitted May 8, 1905. Left hip dislocated posteriorly and upward. One-half inch shortening. Had two closed manipulations. Discharged in six months in a plaster spica with hip reduced. February 15, 1927 the mother wrote that he did not care to talk about his condition as he is a Christian Scientist. However, she said that she saw no improvement and that he was operated on by Lorenz four years ago without benefit and that Lorenz said he had an anterior poliomyelitis.

C. H., female, age three and one-half years. Admitted June 28, 1910. Right hip dislocated posteriorly and upward. Two inches shortening. Closed reduction. Discharged after four months in plaster spica and x-ray showed good reduction. May 8, 1927 letter said, "My leg has never given me any pain and I walk as straight as anyone else".

M. L., female, age seven years. Admitted June 9, 1908. Bilateral dislocation. Had two previous closed operations on the right hip and one on the left. December 14, 1908, the right leg was three inches shorter than the left, the left head was apparently in the acetabulum, the right head was dislocated upward and anteriorly. March 9, 1927, a letter from the mother stated that the patient is very lame and wears a six-inch lift on her shoe. (Not noted, but presumably the right side.)

I was able to get the following x-rays of the seven patients who did return for examination during 1926 and 1927.

Definite conclusions cannot be drawn from this study as the follow-up has been far from successful. The figures do show, however, that the

FIG. 1

J. C., admitted November 3, 1906, male, age eight years. Walked at one year with limp. Both hips dislocated upward and posteriorly. Had five closed operations and plaster up to February 20, 1909. Examination July 6, 1927, now twenty-nine years old. Walks with bad bilateral limp. *RA* 34—*LA* 35. Right hip ankylosed in 15 degrees adduction and 80 degrees flexion. Left hip cannot be abducted and only flexed to 100 degrees. Works as a furrier, sitting down. Has no pain but tires after walking.

FIG. 2

M. I., admitted October 25, 1901, female, age fourteen years. Had always limped. Right hip one and one-quarter inch shortening. Was in the hospital for two months with extension and had one manipulation. Discharged unimproved. Examination May 10, 1926, now thirty-nine years old, has been married for seventeen years and has had three children with easy delivery. Occasionally has slight pain in right hip. Wears one and one-quarter inch lift on right heel. Walks with very slight limp. Examination shows marked pumping and grating. *LA* 31½—*RA* 29, but can be pulled down to 30.

FIG. 3

J. S., admitted December 17, 1902, male, age five and one-half years. Left hip dislocated posteriorly. Reduced December 19, 1902 at Vanderbilt Clinic by Lorenz who said "good acetabulum and cotyloid big". Discharged October 1, 1903 still in plaster. Examination, May 19, 1926, age twenty-nine years. Is a machinist and stands all day. Has never had any treatment since he left the hospital, never any trouble with hip and is perfectly satisfied. Limp is only visible. Motions in hip same as on right side. There is one-half inch of shortening and three inches atrophy of the left thigh.

FIG. 4

H. J., admitted January 22, 1903, male, age nine years. Left hip had one and three-quarters inches shortening. Closed reduction. Discharged in six months in plaster. Examination August 2, 1926, thirty-three years old. Has slight left limp. There is no lift on the shoe, no pain. Works as a public accountant. He considers the result perfect and thinks he does not limp. *RA* 34¼—*LA* 33. Trochanter prominent.

FIG. 5

R. G., admitted February, 1899, female, age thirteen years. Left hip dislocated. Open operation by Whitman in August, 1899. Had several stretchings and tenotomy of the adductors. On July 9, 1904 there seemed to be bony ankylosis in flexion, abduction, and outward rotation. Examination, April 13, 1927, now forty-one years old. Had a Caesarean in 1917. Says she tires easily and is handicapped by limp and absence of motion. *RA* 28¼—*LA* 27½. Hip is firmly ankylosed in marked outward rotation.

FIG. 6

M. F., admitted October 12, 1906, female, age eight years. Right hip dislocated. Had one and three-eighths inches shortening. Had plaster for six months, three years before admission. Had two closed manipulations and was said to be reduced. May 12, 1908 examination showed head in acetabulum, practically no motion, in abduction and outward rotation. Examination October 27, 1926, age twenty-eight years, stenographer. Has no discomfort. Wears three-quarters inch lift on right heel. Walks with limp. *LA* 28¾—*RA* 26½. No pumping. Flexion from 180 degrees to 80 degrees. Adduction normal, abduction 25 degrees, rotation about 50 per cent. normal. Head feels in about proper position.

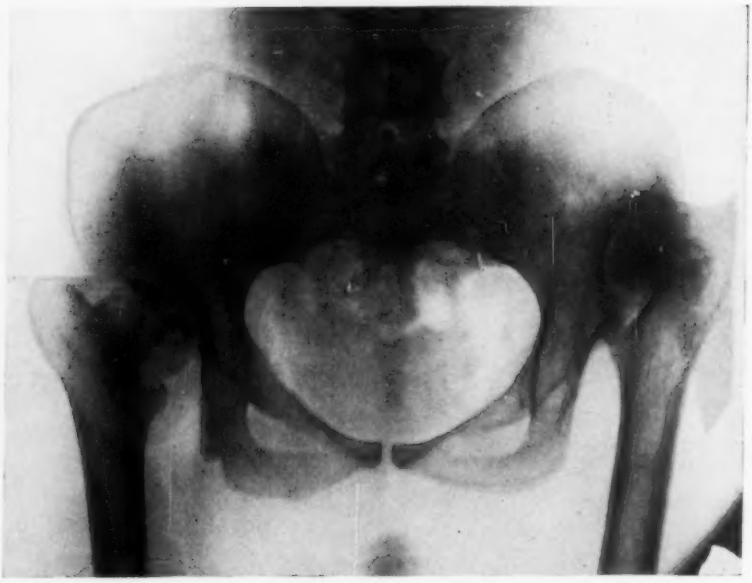

FIG. 7

C. S., admitted February 21, 1907, male, age eight years. Bilateral posterior dislocation. Began walking at three years. Had closed reduction. April 30, 1908, both heads were anterior. Slight outward rotation. Walked well. Examination, November 3, 1926, no treatment since discharge. Had fracture of the left patella in 1918 with operation at Mount Sinai, with good result, but flexion of knee is limited to 80 degrees. Has no pain or discomfort from hips. Works as a wire lather. Walks with marked left limp. Left leg is three-quarters inch shorter than the right. Both heads feel high and posterior. Slight pumping in both. Right motions are normal but left limited 50 per cent. in all directions.

results in cases treated between 1891 and 1910 are not very satisfactory, anatomical and functional cures being not over fifteen per cent. It is my desire to continue this investigation and I hope that in taking up the next period, from 1911 to 1920 I may be able to reach more of the patients, have more thorough records of treatment, and with naturally improved technique in both closed and open methods, find better end results. If the percentage of good results is not markedly increased, then we might conclude that our methods of treatment have been unsatisfactory and should be changed, as we all realize what it means to a child and the parents to go through this long treatment with such a small chance for improvement, especially as so many people with congenital dislocation of the hip really get through life with rather little discomfort and disability.

121 EAST 60TH ST.,
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SUSPENSION APPARATUS FOR PATIENTS IN HEAVY PLASTER DRESSINGS

BY R. M. YERGASON, M.D., F.A.C.S., HARTFORD, CONN.

In the management of heavy patients wearing single, or double, plaster spicas, the difficulties encountered by nurses are very great. Also, especially in the aged subjects, decubitus must be avoided and exercise provided for the uninjured extremities.

For accomplishing these purposes the apparatus here described, has been found to be effective. It is inexpensive and can be employed by anyone, as it is so simple. Three items are essential: a heavy, longitudinal, overhead bar, from which to suspend the patient, a double block and tackle, with hook and locking device, and one or more metal rings, or loops, projecting from the plaster spica at convenient points.

The common, wooden, Balkan frame, which has two longitudinal, overhead rails, is most convenient, as it allows the attachment of the long (two-foot) broomstick trapeze. Two additional longitudinal bars, from another frame, placed close together, are made use of to carry the tackle and, therefore, most of the weight.

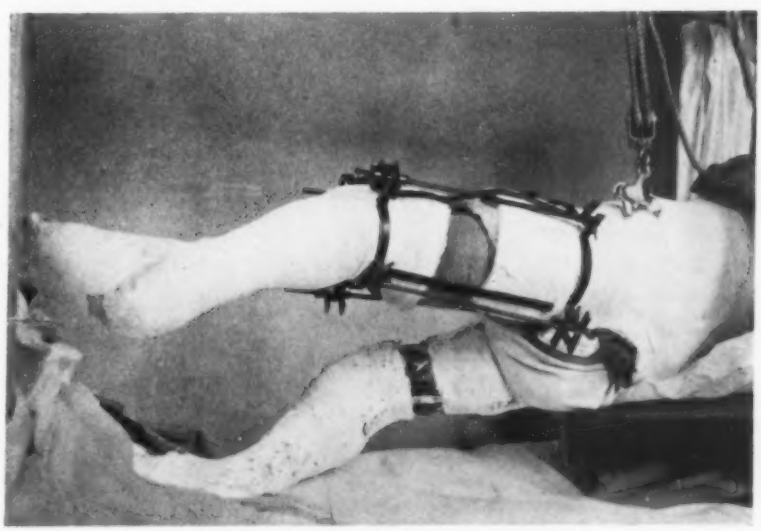

FIG. 1

This patient in double spica, with both femora fractured, easily turned himself on either side, without assistance. (No open operation. Full duty, woodchopper, nine months after injury.)

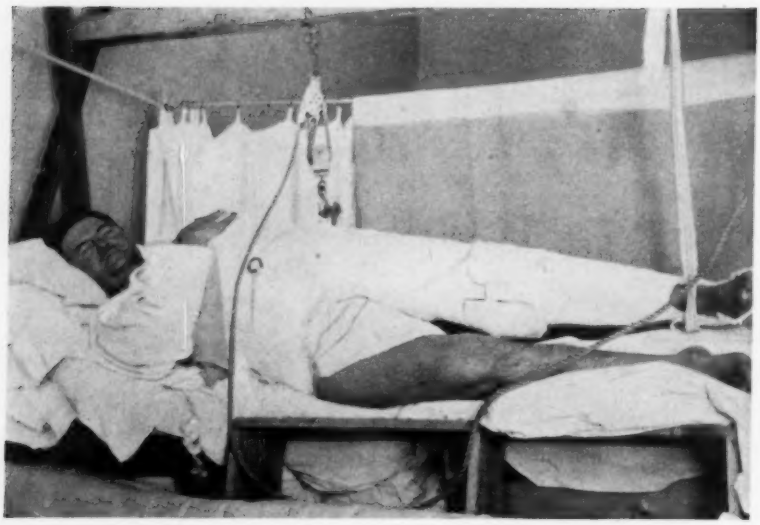

FIG. 2

This 215-pound patient (not including the weight of the spica) easily turned and lifted himself, the ankle being hung in a loop of bandage to facilitate turning. (Case of resection of knee for arthritis.)

The tackle is an ordinary, old-fashioned, fence-stretcher, procurable in any hardware or farmers' supply store, for two dollars and a half. It consists of two double pulleys, on one of which there is a locking device to prevent the rope from slipping, and, also about three feet of chain, designed for fastening the block to a post. On the other block there is a good-sized hook to which the wire is attached in stretching fences. The pulleys are provided with about fifteen feet of half-inch rope. For our use the chain attaches it to the overhead frame.

The metal loops are made from quarter-inch iron rod. A piece fourteen inches long is bent into the form of a small letter *e*, the loop of which is about one and one-half inches high. The long ends are bent slightly to conform to the surface of the plaster spica and are incorporated in it when it is applied.

One of these loops, placed transversely, over the middle of the upper abdomen is all that is necessary, although additional ones, placed longitudinally, on either side of the pelvis help greatly in turning the patient, *et cetera*.

This apparatus was first employed by the writer for a patient, with fractures in the lower third of each femur, in double spica, with knees flexed at an angle of 120 degrees, the body resting upon box supports, to keep it on a level.

The patient speedily learned to turn himself on either side without assistance other than that afforded by the tackle and the iron loops on

FIG. 3

This heavy female, wearing a spica for fracture of the neck of the femur, needed very little assistance to sit up and move about in bed.

the hips. The exercise so benefited him that disability was very materially shortened.

Since the experience with that patient, in December, 1925, this suspension apparatus has been used in practically every case, as the nurses protest strenuously when it is omitted.

The convenience and simplicity of the method are its chief recommendations.

THE PILL ROLLER HAND DEFORMITIES DUE TO IMBALANCE OF THE INTRINSIC MUSCLES. RELIEF BY ULNAR RESECTION

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Little attention is being paid to the intrinsic muscles of the hand as producers of contractures and deformities. Deformities due to relaxation or paralysis of these muscles are better understood; such have been studied and analyzed in paralysis of the ulnar nerve, or in extension contractures of the finger as seen in the claw-hand of the ischaemic contractures. Paralysis of the interossei and lumbricales leads to extension in the metacarpophalangeal articulations, to slight flexion in the proximal and increased flexion of the distal interphalangeal joints. These positions, after elimination of these muscles, represent a new and unstable state of muscle balance. The action of the intrinsic muscles (interossei and lumbricales) is especially important for the execution of fine and rapid movements of the fingers. Strasser recalls the name of musculi fiducinales for these muscles, from the position of metacarpophalangeal flexion and interphalangeal extension, such as is assumed as the fingers of the left hand play over the string-board of a violin.

What of pathological contractures of these intrinsic muscles?

As in paralysis the equilibrium becomes changed to metacarpophalangeal extension and interphalangeal flexion, so in contracture the metacarpophalangeal articulations become strongly flexed while the interphalangeal joints are extended. Both situations represent secondary muscle equilibria, as adjustments to pathological conditions, and it is obvious that the normal equilibrium of the fingers is absolutely dependent upon the physiological tone of the intrinsic muscles of the hand.

The "pill roller" position of the fingers represents isolated contraction of these short muscles. To give strength to the flexion in the metacarpophalangeal articulations, the cooperation of the long flexors of the fingers is, indeed, necessary; but to maintain the fingers straight in the interphalangeal joints, contraction of the interossei and lumbricales is essential. Yet this extensory function is only part of their work. A more important task, and one for which all their power is required, is their antagonism against the flexory action of the long flexors of the fingers.

Accordingly we see that under pathological contractions, as in spastic paralysis, or in contractures, as in the arthritic hand, a "pill roller" position of the finger makes its appearance.

We have observed this type of deformity principally in two types of cases: in the spastic and in the arthritic hand. In the first group the

deformity is due to active contraction of the intrinsic muscles, seen in cases in which there is no flexion contracture of the wrist, or in those in which the latter has been remedied, operatively or otherwise. If there is a strong flexion contracture of the wrist, the resulting passive tension of the extensor muscles swings the equilibrium toward the extensor side, so that the metacarpophalangeal articulations appear hyperextended. When, however, the wrist is free to assume its normal position of slight dorsiflexion, relaxing thereby the extensors of the wrist and fingers, then the interossei and lumbricales are free to contract, and with their contraction, the characteristic "pill roller" position ("shovel hand" of the German) is assumed. In the arthritic hand, one deals with either a reflex or myositic contracture, secondary to the arthritis in the metacarpophalangeal joints. For these articulations the deformity represents the mid-position. Here, also, strong flexion position of the wrist throws the equilibrium toward the claw-hand side of deformity, and we consequently see the "pill roller" fingers develop where the wrist remains free to hyperextend, and not where it is forced into flexion.

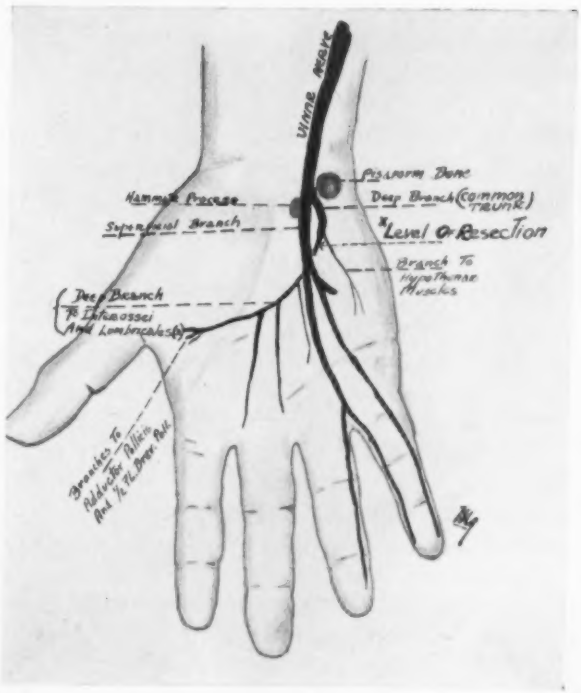

FIG. 1
Resection of motor ulnar nerve to intrinsic muscles of hand.

From such considerations as have been outlined shortly above, we advocate and have carried out, as a means of relief, the resection of the motor branch of the ulnar nerve supplying the intrinsic muscles of the hand. The conservative treatment, which, by splinting and muscle education, aims to restore normal muscular balance, is in no way to be prejudiced; it must have a thorough trial before operative interference should be considered. This applies equally to spastic and arthritic types.

There are numerous cases of the spastic type, however, which resist splinting and reeducational methods. For these, we believe, the operation is an advantageous step, a helpful episode in the otherwise conservative plan of treatment.

Technique: The motor branch of the ulnar nerve for the intrinsic muscles of the hand is easily found (Fig. 1). After making the incision from the proximal end of the hypothenar eminence upward over the wrist for two or three inches, one splits the vaginal fascia (Prentiss) in which the flexor carpi ulnaris is imbedded and finds the nerve almost immediately under it in the muscular compartment for the long finger flexors; farther distally, after division of the volar carpal ligament, which is merely a reenforced continuation of the vaginal fascia, the nerve runs between the pisiform bone and the uncinate process of the os hamatum; one dissects the hypothenar branches which are carefully preserved; one retracts the sensory branch for the ulnar fingers; the deep muscle branch for the intrinsic muscles of the hand and the adductors of the thumb can be easily identified. Then it may be injected with alcohol to paralyze it temporarily, or, as we prefer up to now, it can be resected.

We have applied this operation to only two spastic hands so far, but the results were striking enough to justify this report. In both cases, prior to the operation, the wrists were in strong dorsiflexion; in one as a result of arthrodesis of the wrist and tendon transplantation to the finger;

FIG. 2

Shortly after biceps lengthening and stabilization of foot. Hand as on admission.

FIG. 3

Hand after transplantation of flexors to extensors. Maximum extension of fingers.

in the other it was the natural state of spastic imbalance. This was another demonstration of the vacillation and insecurity of spastic balance and a reminder of how important it is, after all, to secure a degree of voluntary control by educational methods. In these cases extension in the metacarpophalangeal joints, with the wrist extended and the extensors relaxed, would call for definite active effort, but with the contraction of the intrinsic muscles of the hand this was impossible. We, therefore, felt justified in eliminating this obstacle by operation.

CASE 1. M. E., age thirty-seven years. Spastic hemiplegia.

Admission History: Onset sudden, eighteen years ago, while convalescing from an attack of typhoid fever. On arising from bed he "suffered a stroke". Entire right side was flaccid. Later it became spastic. He was comatose two weeks and was unable to talk for three months. Since then he has had no treatment. Does not use right arm. Walks "on right toe".

Physical Examination: Well developed male. General examination negative except for:

Right side of face: facial palsy, central type. Tongue deviates to left.

Right upper extremity: shoulder movement free. Elbow held in 135 degrees flexion (Fig. 2). Only fifteen degrees extension is possible actively and passively. Forearm completely pronated, can be supinated five degrees passively.

Hand: extreme flexion at wrist. Fingers tightly flexed and in ulnar abduction. Active extension possible a few degrees, and only when wrist is forcibly flexed.

Right lower extremity: hip normal. Knee normal. Knee jerk is much more active than on left. Foot: very marked equinovarus deformity.

Operative Intervention: June 23, 1927. Biceps lengthening and tenotomy of the brachialis anticus. Triple arthrodesis, right foot.

Oct. 12, 1927. Muscle transplant, right forearm—flexor carpi ulnaris to radius; flexor carpi radialis and palmaris longus to the extensors of the fingers and thumb (Fig. 3). Note position of maximum finger extension.

Feb. 14, 1928. Resection of branch of ulnar nerve to intrinsic muscles of hand between the hamatum and pisiform bones (Figs. 4 and 5). Active extension of fingers became possible almost immediately.

FIG. 4

After ulnar nerve resection.

FIG. 5

After ulnar nerve resection. Maximum extension of fingers.

CASE 2. H. B., age twenty-six years. "Stroke" following acute illness twelve years before, resulting in spastic hemiplegia.

Arthrodesis of the wrist and tendon transplantation. Increasing contracture of the intrinsic muscles of the hand following arthrodesis in extension position of the wrist. Resistant to conservative treatment.

Resection of the motor branch to intrinsic muscle four weeks ago. Immediately afterwards relaxation of fingers; use of fingers better, less impediment to extension, fingers relaxed.

PURULENT ARTHRITIS

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It is only in recent years that sufficient attention has been paid to the acute infections of the joints. Previous to this time they were placed in the category of the arthritides, especially if they did not progress to the stage of suppuration. These cases, invariably, resulted in ankylosed joints and very often in serious deformities which required subsequent correction. Unfortunately, however, there are still many physicians who treat suppurative joint conditions with expectant and conservative measures as evidenced by a review of the better known monographs and systems of surgery which reveal a diversity of opinion as to treatment of infected joints. The literature abounds in recommendations of various types of treatment for these conditions and particularly the gonorrheal joints, for which autoserotherapy and many forms of intravenous treatment such as sodium iodide, various silver salts, the dyes, etc., are advocated. It is unfortunate that most of these writers overlook the very important fact that monarticular joint infections are invariably surgical problems and should be so treated.

Kaufman classifies exudative lesions of the joints as primary and secondary arthritides. The primary arthritides may be the result of trauma, such as puncture wounds, bullet wounds, crushing, or rupture, and are usually associated with bloody effusion in the joint. They may produce serous, fibrinous, or purulent effusions. The other variety of primary arthritides is the hematogenous type, and this usually has an infectious origin. A primary purulent arthritis may also occur as the result of acute osteomyelitis, but it is more frequently a secondary infection. The secondary arthritides may occur as the result of a transmission of infection from an adjacent focus, such as a preexisting osteomyelitis or suppurative periostitis. Occasionally it may be associated with puerperal sepsis. The most frequent secondary joint infections are the hematogenous type and are metastases from a coexisting infectious disease. The metastatic arthritides are usually purulent types and bacteriologically the same type of organism is found in the exudate as in the primary focus or is the result of a complication following the primary focus. Purulent joints may occur after puerperal infections, septic phlegmons, typhoid, cerebrospinal meningitis, erysipelas, scarlet fever, measles, gonorrhea, and pneumonia. Gonorrheal joint infections occur most frequently in the knee joint, and next in incidence are the foot and hand, followed by the finger and toe joints. Trauma often plays an important part in the localization of infection and the exudate usually invades the para-articular and periarticular tissues. This explains

the fact that there is usually a brawny induration and thickening of the soft parts around the joint, which frequently offer resistance in the restoration of joint function.

Purulent arthritis is far more prevalent in children than in adults. The adult type is usually due to a gonorrheal infection, although it may have a typhoid, pneumococcal, or influenzal origin. In children the above types are also frequently found, and in addition the exanthemata and osteomyelitis of staphylococcus or streptococcus origin are the most frequent causes, from the standpoint of the surgical pathologist. Suppurative joint infections may roughly be divided into three great classes. Firstly, those cases in which the infection is borne into the joint by way of the blood stream and infects the synovial tissue primarily. Secondly, directly penetrating wounds of the joints:—the result of compound fractures, gun-shot wounds, and puncture wounds. Thirdly, the result of acute osteomyelitis which invades the diaphyseal portion of the shaft, adjacent to the epiphyseal plate. This latter source of infection is one which is most frequently overlooked, but deserves much more consideration.

As stated above, that portion of the diaphysis nearest to the epiphyseal plate has a predilection for acute osteomyelitic infection. An anatomical study of the relation of the articular capsule of the humeral portion of the shoulder joint (Fig. 1) reveals that the capsule is fixed to the anatomical

FIG. 1

The upper extremity of the humerus, showing the relation of the articular capsule of the shoulder joint to the epiphysial line. (Drawing from Morris' "Human Anatomy", Ed. 8, P. Blakiston's Son & Co., Fig. 324, 1925.)

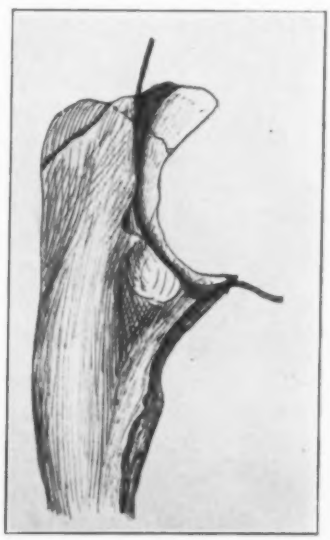

FIG. 2

The upper extremity of the ulna, showing the relation of the articular capsule of the elbow joint to the epiphysial lines. (Drawing from Morris' "Human Anatomy", Ed. 8, P. Blakiston's Son & Co., Fig. 329, 1925.)

neck, sending a prolongation down between the two tuberosities to the diaphysis, projecting medially along the anatomical neck, then crossing the diaphysis, extending downward then obliquely upward to the posterior portion of the anatomical neck, again crossing over to the epiphyseal head at the attachment, continuing on to the superior portion of the greater tuberosity.

The relation of the articular capsule of the humeral articulation of the elbow joint (Fig. 2) is very similar to that of the femur in the knee joint, in that the anterior and posterior attachments are continued up above the epiphysis on to the shaft. The epiphysis of the medial epicondyle is entirely extra-capsular. The ulnar articulation of the elbow joint has its attachment of the articular capsule beginning at the coronoid process, which is entirely diaphyseal and extends posteriorly to the olecranon process, crossing one epiphyseal line.

The articular capsule of the hip joint (Figs. 3 and 4) is attached from the anterior portion of the upper border of the greater trochanter, down along the inter-trochanteric line as far as the medial border of the femur on a level with the lower part of the lesser trochanter. It then runs upward and backward posteriorly, continuing its ascent along the back of the neck

FIG. 3

Upper extremity of the femur, showing the relation of the articular capsule of the hip joint to the epiphysial lines. (Drawing from Morris' "Human Anatomy", Ed. 8, P. Blakiston's Son & Co., Fig. 340, 1925.)

FIG. 4

The upper extremity of the femur, showing the relation of the articular capsule of the hip joint to the epiphysial lines. (Drawing from Morris' "Human Anatomy", Ed. 8, P. Blakiston's Son & Co., Fig. 345, 1925.)

nearly parallel to the inter-trochanteric crest to the anterior superior angle of the greater trochanter.

The relation of the articular capsule of the knee joint to the epiphyseal line (Figs. 5 and 6) shows that, beginning anteriorly on the lower end of the femur, the capsule is attached a distance of approximately two inches above the epiphyseal line. Laterally it dips sharply downward, crossing the epiphyseal line at the epiphysis to which it is attached laterally and posteriorly, and runs obliquely upward over the diaphysis for a short distance, then obliquely downward again, crossing the epiphysis to which the articular capsule is attached, connecting with the upper anterior portion of the capsule. The attachment on the upper end of the tibia is entirely to the epiphysis, except for a very small area posteriorly where it crosses over the diaphysis and its attachment.

FIG. 5

Posterior view of knee joint, showing the relation of the articular capsule to the epiphysial lines. (Drawing from Morris' "Human Anatomy", Ed. 8, P. Blakiston's Son & Co., Figs. 349-356, 1925.)

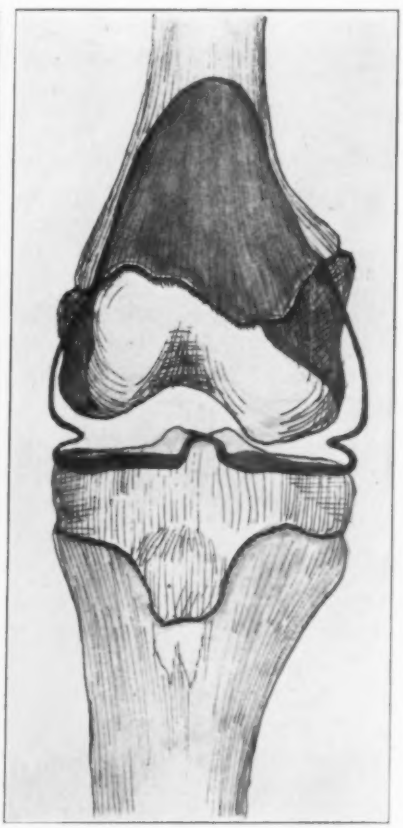

FIG. 6

Anterior view of knee joint, showing the relation of the articular capsule to the epiphysial lines. (Drawing from Morris' "Human Anatomy", Ed. 8, P. Blakiston's Son & Co., Figs. 351-354, 1925.)

Summing up the anatomy of these and other joints in the body we find that the articular capsule of the joint usually includes at least a portion of the diaphysis in the intra-articular space and it is usually the anterior and posterior surfaces of the long bones which are included.

Returning now to the consideration of the pathology involved in suppurative infections of the joints, their origin may be explained by the fact that whereas these multiple infections invaded that portion of the diaphysis near the joint which was extra-articular, however they are not all so discreet, but may invade the intra-articular portion of the diaphysis from which they may drain into the joint. This type of infection is undoubtedly the predominating type in children.

Whether we are dealing with a synovial infection or a bony infection the condition is usually very fulminating in its course and of very short duration. This condition is analogous to a pneumococcus or gonococcus infection in other sources in that there is a sudden shower of infection through the blood stream by way of the synovial membrane into the joint, the acute onset of which is of only very short duration. The purulent arthritis of other sources is likewise very acute and of short duration. The multiple osteomyelitic infections which arise near the epiphyseal line progress very rapidly and often rupture spontaneously and usually heal without sequestrum formation. Frequently there are cases of acute multiple epiphysitis in osteomyelitic infections, especially in children, in which there are many infections which arise near the joints, rupture spontaneously, and usually heal without very much surgical intervention.

In purulent arthritis, Phemister states that cartilage is killed first and most extensively at points of contact and places of opposing articular surfaces. It is broken down partly by the absorptive action of granulation tissue, partly by the erosion of opposing articular surfaces, and partly by the digestive action of proteolytic ferments in the joint exudate.

There are certain factors which are absolutely pathognomonic of acute purulent arthritis: local heat, muscle spasm, resulting in joint rigidity, pain, marked elevation of temperature, and leucocytosis, with predominence of the polymorphonuclear leucocytes. Joint limitation in the early cases differs from that in acute arthritic infections, in that by careful examination and cooperation of the patient slight joint motion may be elicited without pain, for the reason that there is no involvement of the articular cartilage. Effusion is a very important sign and may be elicited in most of the joints. In the knee joint the effusion is easily demonstrable, while, in the ankle joint the effusion may be occasionally demonstrated just anterior and inferior to the external malleolus. In the elbow joint fluctuation may be elicited above the head of the radius and occasionally there is slight fluctuation over the anterior surface of the shoulder joint. The hip joint is the only important joint in the body in which the effusion cannot be demonstrated clinically, as a general rule. Cumston, however, states that, that portion of the capsule forming the posterior culdesac of the hip joint may be palpatated when thickened from disease.

Roentgenological examination may or may not be of any assistance in diagnosis. In the hip joint, for instance, we very often see widening of the interarticular space due to the effusion, and there is slight haziness of the joint outlines. However, a negative roentgenological finding does not denote an absence of an infected joint by any means.

Suppurative joint infections, as previously stated, are most frequently confused with acute rheumatic fever. It is only when the patient has failed to respond to heroic doses of salicylates that the physician's suspicions are aroused to the possible error in diagnosis, and to consideration of a pyogenic infection of the joint. Unfortunately, however, at this stage of the illness the damage has been done and further interference is usually of no avail. In spite of the presence of an infection in the joint, very few progress to frank suppuration, but the joint becomes sterile and either becomes ankylosed with or without deformity, or serious limitation of motion results. Inasmuch as acute rheumatic fever is a direct involvement of the joint surfaces, the slightest attempt at active or passive movement of the affected joint is obviously almost impossible, to say nothing of the serious pain which is involved. Therefore, in acute rheumatic fever there is usually complete limitation of motion in its entire range.

In early purulent arthritis, when the articular cartilage is still unharmed, there is small range of movement which is entirely free from pain. Moreover, in acute rheumatic fever there is always involvement of multiple joints, while joint infections are monarticular, although multiple infections are frequently seen. There is, however, one form of monarticular infection which closely simulates rheumatic fever and should constantly be borne in mind in differential diagnosis. In this group of cases there is usually a history of rapidly developing pain in a joint, together with the other signs of local heat, muscular rigidity, limitation of motion, and possibly of effusion. Immediately thereafter the patient complains of multiple joint pains, which occur in very rapid succession and which do not present the equally definite findings which the original focus has demonstrated. Unless one of these joints, which have been secondarily involved, also develops pyogenic infec-

FIG. 7

Mrs. T. S., aged thirty-nine. Roentgenogram illustrating narrowing of metacarpophalangeal joint space of the left index finger, with destruction of cartilage and bone on both sides of the joint.

tion all the symptoms subside in a very short time, while the original focus continues to be involved, but not with the same degree of severity. The joint originally affected usually proceeds to ankylosis or limitation of motion, and usually with severe deformity. These cases obviously do not respond to salicylates, for we are dealing with secondary saprophytic infections of multiple joints resulting from the original septic joint. The following case will illustrate this type of metastatic infection:

Mrs. T. S., aged thirty-nine (Fig. 7), was admitted to Mt. Sinai Hospital of Cleveland, Ohio, April 4, 1925, with a complaint of rheumatism. The illness started three weeks before entrance, when the patient thought she had grippe.

History revealed severe pain in the left hand, somewhat localized to the index finger. There was also pain in the other hand and in elbows, shoulders, and left hip. The attending physician prescribed medication, but with no appreciable relief. After a few days all pains disappeared except that in the left index finger which persisted. Examination showed that the metacarpophalangeal joint was swollen, severely tender to touch, and very painful on attempted motion. There was slight flexion deformity. There was leucocytosis, 15,400 WBC. Temperature ranged between 103 and 103.2 degrees.

Roentgenological examination on April 4, 1925, showed narrowing of the metacarpophalangeal joint space of the index finger with destruction of cartilage and bone on both sides of the joint.

Diagnosis: Destructive arthritis.

Owing to the marked destruction of the joint and to the fact that three weeks had transpired since the inception of the original focus, arthrotomy was not considered of any value and a splint was applied. The end result was complete ankylosis of the metacarpophalangeal joint of the left index finger with forty-five degrees flexion deformity.

Because of its monarticular character this condition is very often considered tuberculous, but in tuberculous joints we do not have leucocytosis, and the progress is usually very insiduous. There is also a complete limitation of joint movement, as in acute rheumatic fever, except in synovial tuberculosis. In children the tuberculin reaction is an aid to diagnosis, and there is usually sufficient roentgenological evidence to differentiate these two conditions. Traumatic synovitis must also be seriously considered, for it is often very difficult to determine whether or not one is dealing with an infection; for there is pain, limitation of motion, effusion, and occasionally slight elevation of temperature. There is, however, no local heat, no leucocytosis, and no evidence of a systemic reaction to infection. Pain and muscle spasm are relieved by immobilization, while in purulent arthritis this usually persists. Hemophilic arthritis is another joint condition which must constantly be borne in mind, in spite of the fact that it occurs only rarely. There is no known cause or significant trauma, and it may be associated with ecchymosis of the adjacent region of the joint. There is slight elevation of temperature. The effusion absorbs very slowly and frequently recurs. There is resultant muscle atrophy. Roentgenograms show nothing pathognomonic. The history may be of assistance because of hereditary transmission and multiple joints may be involved. If one has the slightest suspicion of the possibility of a hemophilic arthritis it may be well to study the blood picture before resorting to any radical

measures. Rarely, acute pyogenic arthritis of the right hip has been confused with acute appendicitis and acute pelvic inflammatory conditions, but with careful examination and cooperation of the patient one is able to differentiate the muscular spasm of the right rectus from that of the hip joint muscles. Then too, there may be a localized point of tenderness over the head of the right femur.

Although purulent arthritis is widely accepted as a surgical condition, there is still some variation as to the exact method of treatment to be adopted. Indications for immediate intervention in septic joints are quite analogous to those in acute osteomyelitis,—in other words, early exploration as soon as a clinical diagnosis of a septic joint has been made, utterly disregarding negative roentgenological findings. There are a number of writers who advocate a frank exposure of the joint by incision followed by drainage. Cotton remarks, very tersely, but wisely, that "The treatment of suppuration within a joint by incision and drainage is an outrage". He further states that joints are relatively tolerant to infections of various sorts and that they are sterilizable so long as infection is confined to the synovial cavity. The treatment of choice, therefore, is immediate evacuation of the infected material within the joint by means of a trocar cannula, followed by lavage with 1 to 5,000 solution of acriflavine or mercurochrome or Dakin's solution. In scrupulous aseptic surgical technique, Cotton employs 1 to 15,000 corrosive sublimate in normal salt solution for lavage.

With the exception of the hip joint, the other joints of the body may be readily aspirated. The shoulder joint may be approached from its anterior aspect by inserting the needle on the level with the coracoid process from the external fibers of the deltoid to the outer sides of the muscles inserted on the coracoid process. Another avenue of approach is between the acromion process of the scapula and the head of the humerus, the arm being in forty-five degrees abduction, thus relaxing the upper part of the capsule. After the aspiration has been completed, the arm is immobilized in the abducted and externally rotated position.

The elbow joint may be approached over the region of the radiohumeral articulation, inserting one trocar into the space between the lateral condyle of the humerus and the head of the radius, and is immobilized in the right-angle position.

The wrist joint is treated by the insertion of one trocar on the ulnar side dorsally into the joint between the triangular ligament and the semilunar bone, passing outside of the tendons of the common extensor and the extensor of the little finger. On the radial side, the trocar is inserted between the interspace of the radius and scaphoid bones, and after completing the aspiration, the joint is immobilized in forty-five degrees dorsiflexion.

The hip joint, however, has been much more difficult to approach, in the writer's hands at least, and he has found it necessary to explore the joint from the posterior aspect. The method of Ober is excellent for this purpose, for it is not difficult and gives an opportunity for dependent drainage by way of the posterior surfaces. The joint capsule is incised to an

extent merely to permit the insertion of a small-bore rubber tube, as used in the Carrel-Dakin technique, and this is sewed in place with plain catgut. The tube is removed as soon as all evidence of the acute infection of the joint disappears. The catgut usually absorbs in five to seven days, which is approximately the time required for the acute joint symptoms to subside, and the wound is permitted to heal.

In the knee joint Cotton inserts two trocars in the sub-patellar pouches through which the fluid is carried into the joint cavity. The writer inserts the trocars on either side of the patellar tendon just below the patella, where it is certain to enter the joint cavity, first breaking the skin at the point of entrance with a scalpel. By means of a glass syringe which is connected to the larger trocar with a small-bore rubber tube of the Dakin type the fluid is injected into the joint. The exudate then is evacuated from the joint through the smaller trocar, setting up a small amount of negative pressure, affording a better opportunity for the exudate to be washed out. Sufficient fluid is employed until it returns clear, a dressing is applied and the knee is fixed to a posterior molded leg splint, including the ankle by the application of a cotton elastic compression bandage.

Under the similar surgical precautions the ankle joint may be aspirated by inserting the two trocars on either side just anterior to the malleoli and approximately one centimeter above the tip. Inserting the needles in the horizontal plane at this point gives access to the subastragaloid joint. The tibio-astragaloid joint may be entered by inserting the trocar one and one-half centimeters above the tip of the malleoli and anterior to that, pointing the needles upward in a slightly oblique direction.

If any difficulty is encountered in aspirating the shoulder, elbow, wrist, or ankle joints there need be no hesitancy in exposing the articular capsule by an incision and then inserting the trocar, after which the incision may be closed.

Ordinarily one course of aspiration and lavage is sufficient to eradicate most early joint infections, although very often this is not the case. After a few days of recession of the symptoms, there may be another rise in temperature and the effusion recurs, in which event it is necessary to repeat the aspiration and lavage. In other words, aspiration and lavage should be repeated every five or six days until all the acute symptoms have completely and permanently subsided, and there should be no hesitancy in repeating the procedure many times. One of the cases of this series had a recurrence of a hip joint infection at intervals of about six months, in each instance a posterior arthrotomy was done, and there is complete restoration of joint function.

Only in a very few instances, possibly puncture or gun-shot wounds of the joint, is there ever any indication for a radical incision into a joint, and certainly not in the synovial joint infection. If repeated aspiration and lavage are unsuccessful, the condition is undoubtedly the result of an

osteomyelitis in which there has been bone destruction resulting in sequestrum formation. These cases should be studied roentgenologically and should be incised at the point on the shaft where the roentgenogram shows bone change, but not into the joint itself. Care should also be taken not to puncture the articular capsule.

Immobilization of the affected joint after the methods advocated recently by Porter, together with a cotton elastic compression bandage if practicable, is a very important adjunct in the treatment. Phemister also advocates separating the opposing joint surfaces by traction, although he states a considerable pull is required to accomplish this.

As for the after-treatment, it may be stated arbitrarily that active motion should begin approximately ten days after all the acute symptoms have subsided. This is supplemented by passive movements, massage, and thermotherapy, preferably in the hands of an experienced physiotherapist.

Twenty patients with one or more joints involved were treated according to the method described above. Twelve of the twenty cases had involvement of one joint, and the remaining eight had three or four joints involved. The total number of joints treated was thirty-two. The knee joint was most frequently infected. Of the twelve knee joints treated, five were known gonococcal infections, of which two resulted in complete ankylosis, one obtained 100 degrees of flexion, and the remaining two resulted in complete restoration of joint function. Of the remaining seven knee joints treated, the staphylococcus aureus and albus were the predominating organisms found. The end results in these seven cases were as follows: active flexion limited to ninety degrees in one case, complete restoration of function in the remaining six.

There were five ankles treated in this series, of which two were known to be gonorrheal, one due to staphylococcus albus and one to staphylococcus aureus, and in the remaining case the organism was not determined. All five patients obtained complete restoration of joint function.

The hip joint was treated in three cases, two of which were due to staphylococcus aureus infections, and in the third the organism was not determined. All three cases have obtained complete restoration of function, in spite of the fact that one case had a complete recurrence of all symptoms and drainage six months after the first infection.

Three shoulder joint infections were treated, all of which had complete restoration of function. Two were staphylococcus albus infections, and the third probably a gonococcal infection.

The elbow was involved in four instances. In one case both elbows were involved, in a staphylococcus albus infection. In one elbow there was a recurrence of the infection, two months and again three months, after the first, and in the other elbow three months afterwards. There has been complete restoration of function in both elbows. The third was due to a staphylococcus albus infection and has gone on to complete restoration of function, while the fourth was a questionable gonococcal infection which

resulted in complete ankylosis. Typical organisms, however, were never isolated.

Three wrist joints were treated, in none of which has any typical organism been found. One was a questionable gonococcal infection, it being the same patient who suffered the ankylosed elbow, and complete ankylosis resulted. The other two patients obtained complete restoration of function.

A study of the case reports will show that invariably in those cases in which early diagnosis has been made and early treatment instituted, the best end results have been obtained; and in every case in which ankylosis has resulted, it was due either to neglect or mistaken diagnosis, and erosion of the articular cartilage had already taken place. In none of the joints treated has there been any evidence whatever of aggravating the infection present and resulting in frank suppuration. There is very little risk if the technique is carried out under strictly aseptic precautions. In other words, there is no danger in attempting to aspirate a joint with even a question of diagnosis of infection, but very serious harm may be caused by overlooking a purulent joint infection and by delaying aspiration.

A point of criticism may be raised in failure to isolate an organism in some of the cases here reported. The greatest care was exercised in seeking a causative organism, both by direct smear and by cultures, but in spite of the skill and the perseverance of the bacteriologist, none was discovered. In some of the cases this may be attributed to the fact that the purulent material remained in the joint cavity for a sufficient period of time to render it attenuated and to destroy the typical morphology of the invading organism.

In conclusion the writer wishes to emphasize the fact that acute purulent joint infections occur very frequently and are primarily surgical problems. They may be either synovial or osteogenic infections and the latter are the predominating type in children, usually secondary to osteomyelitis. As in acute osteomyelitis, immediate surgical intervention should be resorted to and repeated as often as necessary, depending upon the persistence of acute symptoms of infection. There is never any indication for frank incision of a joint in synovial infections and rarely in osteogenic infections, and in these the incision should be confined to that portion near the joint which has been demonstrated by roentgenograms to show bone change, avoiding the articular capsule. The end results in aspiration and lavage of purulent joints are very good and are dependent entirely upon the length of time that has transpired between the inception of the infection and the treatment.

The writer wishes to express his appreciation to Dr. T. Wingate Todd, Professor of Anatomy, School of Medicine, Western Reserve University and to Dr. Walter G. Stern for their kind cooperation, and to P. Blakiston's Son and Company, Philadelphia, for their permission to reproduce the accompanying cuts from Morris' "Human Anatomy".

CASE REPORTS

CASE 1. C. L., female, aged eighteen.

Admitted: July 24, 1923, with complaint of painful left knee of eight days' duration. Pain so severe that she went to bed. Physician gave salicylates with no appreciable relief.

Examination: Temperature 102 degrees. Leucocytosis 15,750 WBC. Shiny swelling left knee. Marked effusion in joint. Local heat. Complete limitation of motion with severe pain.

X-ray: Negative for disease in left knee.

Operative Notes: Left knee joint aspirated and large quantity of seropurulent fluid obtained. Irrigated with 1 to 10,000 sublimate solution, followed by saline and acriflavine until returned clear. Immobilized, and compression bandage applied.

Progress Note: Temperature rapidly returned to normal and active motion was begun. Six months later patient has complete restoration of function with no disability.

Bacteriological Findings: Gram negative diplococci typical of gonococci isolated in culture.

CASE 2. A. L., female, aged nine.

Admitted: December 3, 1924, with complaint of pain in right leg. Four days previous to admission patient fell and injured right hip and has suffered a great deal of pain on attempted motion of right leg, accompanied by fever and chills.

Examination: Tenderness over anterior and posterior surfaces of right hip joint. Slight flexion adduction position with muscle spasm and severe pain on attempted motion. Leucocytosis 13,000 WBC. Temperature 102 degrees.

X-ray: Negative for disease in right hip joint.

Operative Notes: December 3, 1924. Posterior arthrotomy of right hip joint after the method of Ober, seropurulent fluid obtained following incision into joint capsule. Dakin's tube inserted and sutured in place. Irrigation with Dakin's solution.

Progress Note: December 5, 1924. Temperature 99 degrees and normal on fourth day. January 15, 1926, discharged, patient able to walk with aid of crutches, incision almost completely healed, and normal range of motion in hip joint without pain.

Present Condition: Complete return of function of right hip joint without disability.

Bacteriological Findings: Smear, no organism seen, numerous pus cells. Culture, no growth.

CASE 3. R. M., female, aged twenty-six (Fig. 8).

Admitted: December 29, 1924, with complaint of pain in the joints.

History: Patient became suddenly ill five days ago with severe pain in the left knee. Also had indefinite pain in neck, back, left hip, right shoulder, both wrists, and right ankle. All disappeared in about two days except for the left knee and right ankle. Patient has had profuse night sweats with considerable elevation of temperature. Definite history of acute gonorrheal urethritis.

Examination: January 6, 1924. Local heat, periarticular swelling and effusion of left and right ankle, complete limitation of knee, muscle spasm right ankle. Temperature 101.8 degrees to 102.6 degrees. Blood count, WBC. 18,000.

X-ray: Left knee and right ankle negative.

Operative Notes: January 10, 1925. Aspi-

FIG. 8

Case 3. Range of motion of right ankle.

ration of left knee and right ankle, and small amount of seropurulent fluid obtained from each, followed by irrigation with 1 to 4,000 solution acriflavine, followed by immobilization.

Progress Note: February 14, 1925. Normal temperature and no pain.

Bacteriological Findings: Smear, occasional gram negative diplococcus found.

January 10, 1927: Complete ankylosis of left knee, normal range of motion of right ankle.

CASE 4. B. B., female, aged nine (Fig. 9).

Admitted: February 11, 1925, complaining of swelling and pain in right knee joint, which started about thirteen days ago. She also had greenish-white vaginal discharge which was quite profuse. Was unable to urinate for two days and blood-spotting lasted about two days. Had indefinite pain in left elbow a few days later which disappeared shortly afterward.

Examination: Swelling and fluctuation over right knee joint, local heat, tender to pressure, muscle spasm in slightly flexed position, motion very painful, elevation of temperature, leucocytosis, 15,000 WBC.

Operative Notes: February 12, 1925. Aspiration of knee joint, obtained serosanguinopurulent fluid with some organized fibrin. Irrigated with 1 to 4,000 acriflavine until fluid returned clear. Adhesive traction applied to right leg with compression bandage to knee. Temperature remained elevated and effusion recurred.

February 24, 1925. Aspiration of right knee repeated, and small amount of seropurulent fluid obtained with many fibrinous flakes, then profusely irrigated with 1 to 4,000 acriflavine until returned clear.

Progress Note: Temperature gradually returned to normal, muscle spasm and tenderness completely disappeared, and knee in complete extension. Traction removed and active motion encouraged, followed by usual course of physiotherapy.

Present Condition: Complete extension of knee joint, active flexion 135 degrees with no pain or other disability.

Bacteriological Findings: Smear shows occasional pus cells and occasional gram negative diplococci found. Apparently gonococcus.

CASE 5. A. S., male, aged forty-six.

Admitted: February 18, 1925. Four days ago developed pain and swelling in left ankle accompanied by fever and headaches. Pain and swelling continued and day before admission right knee became painful and swollen. Three years ago patient had gonorrheal urethritis with epididymitis, and recently has had recurrence. Physician prescribed capsules without appreciable effect.

Examination: Right knee: slight flexion deformity, local heat, effusion, periarticular swelling, muscle spasm, complete limitation of motion. Left ankle: tenderness on pressure with swelling, local heat, fluctuation, muscle spasm, elevation of temperature and leucocytosis.

Operative Notes: February 21, 1925. Aspiration of right knee, considerable purulent fluid obtained; lavage with one liter of 1 to 4,000 solution acriflavine. Aspiration of left ankle, purulent fluid obtained, followed by irrigation with one liter acriflavine 1 to 4,000 solution.

FIG. 9

Case 4. Range of motion of right knee joint.

March 4, 1925, active motion attempted in right knee and left ankle, followed by baking, massage, and manipulation.

Progress Note: January 5, 1927. Complete ankylosis of right knee in slight flexion deformity. Normal range of motion in left ankle, no pain.

Bacteriological Findings: Direct smear, occasional gram positive cocci seen, culture, no growth.

CASE 6. J. C., female, aged twenty-seven.

Admitted: February 26, 1925, complaining of pain in left ankle which began about twelve days ago and was accompanied by swelling and elevation of temperature. Shortly afterward the pain and swelling developed in the right elbow, right wrist, right knee, and right ankle in rapid succession. Patient was severely ill and physician was called in who diagnosed case as rheumatism and prescribed medicine. Condition became progressively worse and patient was sent to hospital.

Examination: Patient severely ill, leucocytosis 14,600 WBC. Elevation of temperature, swelling and effusion in left ankle, right knee, right wrist, and right elbow. Limitation of motion of these joints with pain.

X-ray: These joints show slight cloudiness of ankle joint. No evidence of disease of this or the other joints.

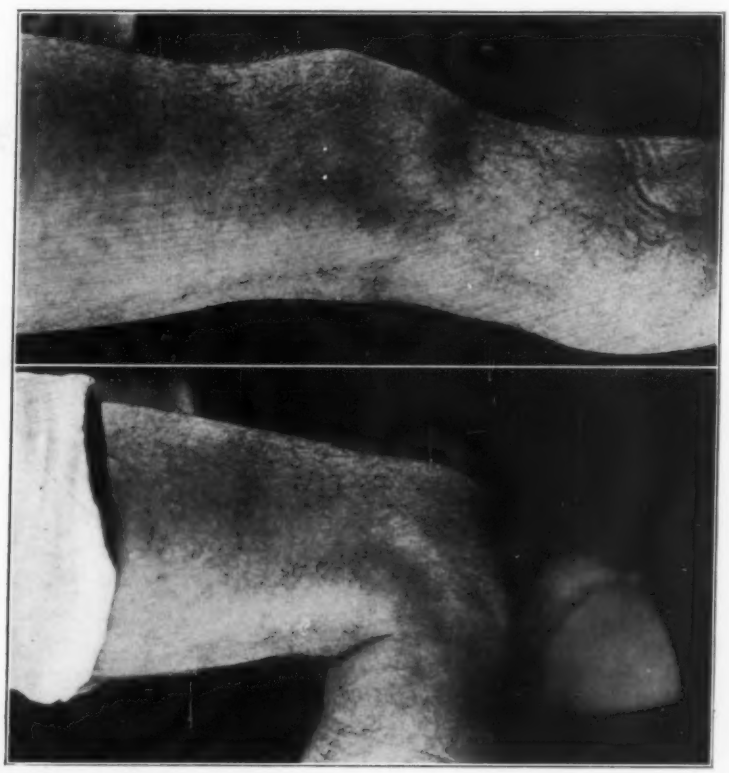

FIG. 10 (Above)

Case 7. J. Z., male, aged twenty-eight. Range of extension of right knee.

FIG. 11 (Below)

Case 7. J. Z., male, aged twenty-eight. Range of flexion of right knee.

Operative Notes: March 27, 1925. Aspiration of left ankle, right knee, right wrist, and right elbow, followed by irrigation with 1 to 4,000 acriflavine solution, followed by immobilization. Temperature gradually returned to normal and general condition improved. Active motion was begun and followed by physiotherapy.

Present Condition: Normal range of motion of left ankle and right knee with no disability, complete ankylosis of right wrist joint in slightly dorsiflexed position. Complete ankylosis of right elbow joint including head of radius at right-angle position in forty-five degrees pronation.

Bacteriological Findings: Direct smear and culture. Many pus cells. Scattered gram negative biscuit-shaped intracellular cocci with morphological characteristics of gonococci.

CASE 7. J. Z., male, aged twenty-eight (Figs. 10 and 11).

Admitted: March 13, 1925, with complaint of pain in the right knee of three weeks' duration. Sustained laceration of internal lateral ligament which improved for the first four days and was followed by a sudden elevation of temperature, chills, pain in knee joint and muscle spasm. Treated for three weeks by osteopath, who employed active and passive movement.

Examination: Marked effusion in right knee joint which is swollen and tender to pressure, limitation of motion with pain. Temperature 101.5 degrees. Leucocytosis.

X-ray: Shows right knee joint cloudy with no other evidence of disease.

Operative Notes: March 14, 1925. Aspiration of knee joint and large quantity of purulent and flocculent material obtained. Irrigated with 1 to 4,000 acriflavine solution until fluid was returned clear. Knee joint immobilized and moderate compression applied.

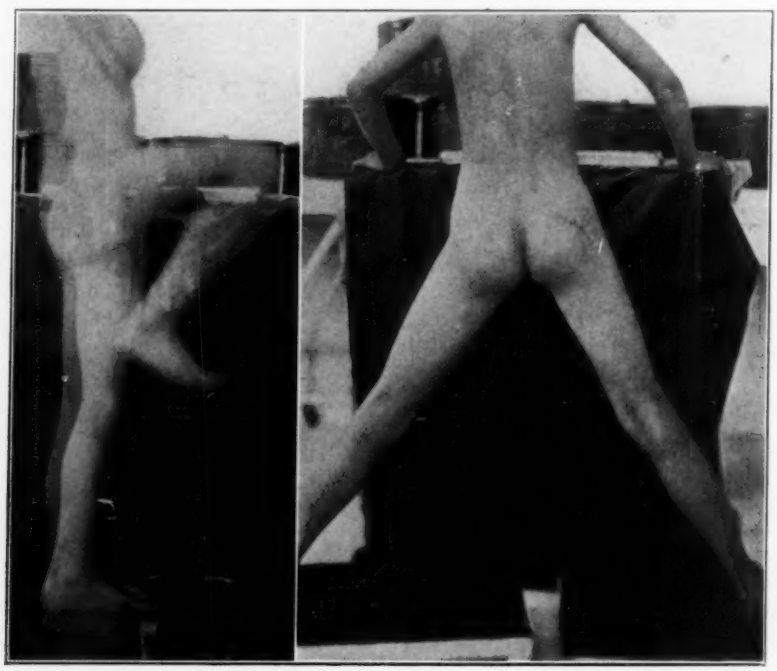

FIG. 12 FIG. 13

Case 8. Range of flexion and extension of right hip joint.

Case 8. Range of abduction of right hip joint.

Progress Note: March 22, 1925. Temperature still ranging around 101.5 degrees, slight recurrence of effusion, knee joint again aspirated and irrigated with acriflavine solution, following which temperature dropped to normal and remained so. Moderate active motion begun, followed by course in physiotherapy.

Bacteriological Findings: Direct smear, no true pus cells, few gram positive cocci, occasional gram negative organisms, no gonorrheal cocci found, culture, no growth.

Present Condition: Active flexion 100 degrees and normal extension with no pain, no other discomfort.

CASE 8. H. R., male, aged eleven (Figs. 12 and 13).

Admitted: June 30, 1925, complaining of pain in right hip which began suddenly about five days ago with slight elevation of temperature.

Examination: Tenderness over right hip joint anteriorly and posteriorly, marked limitation of motion of hip joint with muscle spasm in slightly flexed and adduction position. Leucocytosis, 30,000 WBC.

X-ray: June 30, 1925. No evidence of disease in right hip joint.

July 7, 1925. Shows widening of joint space and blurring of outlines.

Operative Notes: July 9, 1925. Transferred to Orthopaedic Service and diagnosis of purulent arthritis made. Posterior approach according to the Ober method, and after joint capsule had been opened, small amount of seropurulent exudate was obtained. A small rubber Dakin's tube was sewed into the joint capsule and wound irrigated periodically with 1 to 4,000 acriflavine solution. Temperature immediately returned to normal. Tube removed after fourth day and wound permitted to close. Active motion begun followed by usual routine of physiotherapy treatment.

X-ray: August 21, 1925. Entire hip joint shows a cloudy washed-out appearance. There is atrophy of entire head of femur and upper end of shaft. The outline of the acetabulum is indistinct in places and no definite area of bone destruction.

Progress Note: August 4, 1925. Secondary closure of wound.

Present Condition: Normal function of right hip joint with no pain or other disability.

Bacteriological Findings: No organisms found in culture or smear.

CASE 9. R. E., female, aged six (Fig. 14).

Admitted: July 18, 1925, with complaint of pain and swelling of left knee.

History: Three weeks ago accidentally pierced left knee joint with needle, four days later became badly swollen and painful, especially on motion. Temperature remained about 100 degrees. Treated with rest and heat applications with no relief. Marked effusion in left knee joint. Tenderness on pressure. Slight amount of movement but with muscle spasm and pain. Temperature 101.4 degrees. Leucocytosis 15,500 WBC.

X-ray: The knee joint space is widened. There is swelling of the soft tissues of the inner aspect of the joint. There are no areas of bone destruction and no evidence of foreign body.

Operative Notes: July 18, 1925. Aspiration of left knee joint, large amount of seropurulent fluid obtained with fibrin. Joint irrigated with mercurochrome solution 1 to 5,000, immobilized, and compression bandage applied. Temperature returned to normal

FIG. 14

Case 9. R. E., female, aged six. Range of motion of left knee joint.

the fourth day after operation. No return of fluid. Active motion begun following removal of splint and bandage.

Present Condition: Normal range of motion of left knee joint with no disability.

Bacteriological Findings: Culture and growth. A typical cocci found.

CASE 10. A. F., male, aged eleven (Figs. 15 and 16).

Admitted: November 8, 1925, with pain and muscle spasm of right hip joint of five days' duration. Temperature had remained above 102 degrees. Had acute osteomyelitis of left humerus for which he was operated on January 30, 1925, which is now completely healed.

Examination: Tenderness over anterior and posterior aspects of right hip joint. Local heat with muscle spasm and complete limitation of motion. Hip in slight flexion adduction position. Temperature 104 degrees. Leucocytosis 16,000 WBC.

X-ray: Negative.

Operative Notes: November 9, 1925. Arthrotomy of right hip joint by the Ober method and seropurulent fluid obtained, and irrigation of joint with acriflavine solution 1 to 4,000. Dakin's tube in place, which was removed in three days, during which time wound was irrigated every two hours with Dakin's solution. Buck's extension applied.

Progress Note: Temperature immediately subsided and active motion begun. Complete return of function after six weeks.

Re-admitted: May 4, 1926 with exacerbation of all symptoms and findings of right hip joint. An arthrotomy after the Ober method again done. Seropurulent fluid again obtained, tube in wound and again irrigated with Dakin's solution every two hours.

X-ray: May 4, 1926 showed widening and slight cloudiness of joint space of right hip.

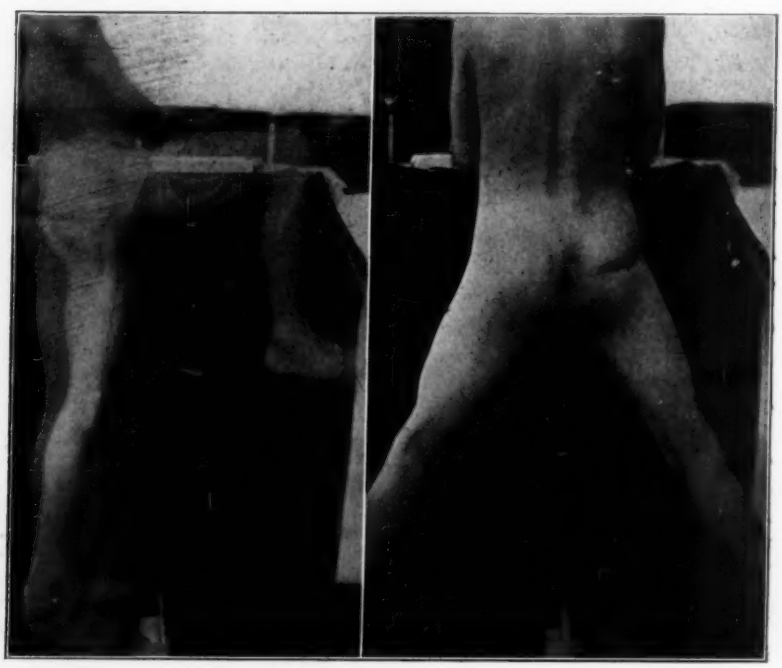

FIG. 15

Case 10. A. F., male, aged eleven. Range of flexion and extension of right hip joint.

FIG. 16

Case 10. A. F., male, aged eleven. Range of abduction of right hip joint.

Progress Notes: General condition improved rapidly and active motion was immediately started.

January 10, 1927. Developed exacerbation of osteomyelitis of left humerus but has normal function in right hip joint.

Bacteriological Findings: No organism found in smear or culture in instance of joint aspiration.

CASE 11. L. G., male, aged fourteen.

Admitted: February 25, 1926, with throbbing severe pain, swelling in the left knee and right ankle.

Examination: Temperature 102.5 degrees, leucocytosis, local heat, effusion, tenderness on pressure, muscle spasm with severe pain on attempted motion in left knee and right ankle.

X-ray: Negative for disease of left knee and right ankle.

Operative Notes: February 27, 1926. Left knee and right ankle aspirated and seropurulent fluid obtained from each. Irrigated with 1 to 4,000 acriflavine solution. Both joints immobilized, slight compression bandage to left knee.

Progress Note: Left knee continued to improve, but on April 9, developed tenderness and fluctuation over region of internal malleolus right ankle. Was aspirated and purulent material obtained. Rubber tube inserted and irrigated with Dakin solution. Rubber tube extending through joint capsule.

April 10, 1926. Recurrence of pain and swelling of left knee, elevation of temperature. Left knee joint again aspirated and purulent fluid obtained, irrigated with acriflavine solution 1 to 4,000. Temperature returned to normal after fourth day and remained so. Active motion begun, followed by course of physiotherapy treatment.

Bacteriological Findings: No organism found on direct smear and no growth on culture.

Present Condition: Normal range of motion of left knee and right ankle with no disability.

CASE 12. S. G., male, aged eighteen.

Admitted: February 28, 1926 with complaint of pain in left elbow for the past four or five days. Has had frequent attacks of pain and swelling near the left shoulder, both knees and ankle joints requiring numerous incisions followed by drainage, all of which healed. Elbow joint is hot, swollen, very painful on motion, and has faint fever.

Examination: Leucocytosis, temperature 100.8 degrees, local heat and swelling around left elbow joint. Fluctuation over region of head of radius, muscle spasm with limitation of motion.

X-ray: Negative for disease of left elbow joint.

Operative Notes: Aspiration of left elbow joint through small incision over head of left radius with drainage and immobilization of elbow joint at angle of ninety degrees.

Progress Note: Temperature normal on fifth day, splint removed, active motion begun, followed by physiotherapy.

Diagnosis: Acute epiphysitis of left humerus at elbow joint.

Bacteriological Findings: Smear and culture show presence of staphylococcus albus.

CASE 13. R. C., male, aged twelve.

Admitted: April 14, 1926, with complaint of sore shoulder of three weeks' duration with increase in pain and swelling. Temperature on admission 101.6 degrees, elevated to 105.2 degrees the following day, accompanied by chills.

Examination: Marked fluctuation over anterior surface left shoulder joint, hyperaemia, local heat, periarticular swelling, tenderness to touch with muscle spasm, with limitation of motion of left shoulder joint. Healed scar over left leg and thigh, the site of chronic osteomyelitis.

Operative Notes: April 15, 1926. Aspiration of left shoulder through a small incision anteriorly and purulent fluid obtained. Irrigated with 1 to 4,000 solution acriflavine. Shoulder joint immobilized. Temperature gradually receded to normal and again became elevated because of an acute osteomyelitis of the left femur, upper end.

Progress Note: January 11, 1927. Left shoulder completely healed, normal range of motion.

Bacteriological Findings: Purulent material staphylococcus pyogenes aureus.

CASE 14. R. F., female, aged twenty-nine.

Admitted: April 18, 1926, with complaint of rheumatism of five weeks' duration. Original lesion in right wrist. Then migrated to left knee, followed by indefinite joint pains in ankles, right elbow, and left wrist. Has deep-seated pain in right wrist and left knee with temperature. Treated intensively with salicylates without any effect on pain or temperature.

Examination: Local heat and effusion over right wrist joint. Swelling of entire right hand and fingers. Tenderness on pressure over carpal bones. Left knee. Swelling and local heat with effusion in joint extending into suprapatellar pouches. Joint held at angle of eighty degrees flexion, with very little range of active and passive motion from this point with pain.

X-ray: Negative for disease of right wrist or left knee.

Operative Notes: May 3, 1926. Under anaesthesia, trocar inserted into left knee joint on either side of patellar tendon and about fifty cubic centimeters of salmon-tinted pus escaped. The joint cavity was then irrigated with flavine 1 to 4000 solution. Adhesive extension applied. Another trocar inserted into right wrist joint above styloid process of radius. No fluid escaped, but a number of flocculent particles resembling fibrin were washed out after irrigation with 1 to 4000 acriflavine solution. Splint applied to right wrist in slight dorsiflexion of wrist joint.

Progress Note: Fourth day, temperature was normal and has remained normal since. Pain and swelling completely subsided.

Bacteriological Findings: Direct smear. Numerous degenerated pus cells. No typical organism seen. No growth on any kind of culture media.

Present Condition: Normal range of motion of left knee and right ankle.

CASE 15. S. A., male, aged eight (Figs. 17, 18, 19, and 20).

Admitted: June 6, 1926, with acute osteomyelitis of left tibia, very severely ill, temperature 103.8 degrees, pulse 140. Tibia opened immediately. Two days later developed similar focus in upper end of left femur which was also trephined. A blood culture showed presence of staphylococcus pyogenes aureus in the blood stream. Then developed multiple abscesses in various parts. June 11, 1926, transfusion was done with father as donor and patient immediately began to improve. October 4, 1926, developed pain and swelling of left elbow joint. Elevation of temperature.

Examination: Marked effusion left elbow joint, tenderness, muscle spasm, limitation of motion with pain.

X-ray: Negative.

Operative Notes: Aspirated joint and obtained small quantity of seropurulent fluid. Joint irrigated with 1 to 4000 acriflavine solution and immobilized.

Progress Notes: Temperature immediately subsided and obtained normal joint function within ten days.

November 22, 1926. Complained of pain in right elbow, with symptoms and findings same as left elbow, effusion, muscle spasm, limited motion, tenderness, elevation of temperature, leucocytosis.

X-ray: Negative.

November 23, 1926. Right elbow joint aspirated and obtained small quantity of seropurulent and sanguinous exudate and irrigated with 1 to 4000 acriflavine solution and immobilized.

There was immediate improvement and complete active function of elbow within two weeks.

November 29, 1926. Exacerbation of condition in left elbow as original infection.

November 30, 1926. Left elbow again aspirated and small quantity of serous fluid obtained.

December 28, 1926. Exacerbation of condition of right elbow with marked effusion in joint.

December 29, 1926. Right elbow aspirated and amount of seropurulent fluid obtained.

January 15, 1927. Right elbow shows a well circumscribed, entirely healed area of destruction in lateral condyle of humerus.

Left elbow shows periosteal proliferation along proximal end of ulna and olecranon with no definite area of bone destruction.

Bacteriological Findings: Showed presence of staphylococcus aureus after first aspiration of left and right elbows.

FIG. 17

Case 15. Range of motion of left elbow joint.

FIG. 18

Case 15. Range of motion of right elbow joint.

CASE 16. I. R., male, aged twenty-three.

Admitted: September 7, 1926, complaining of pain and swelling of right knee. Six days ago patient noticed some pain in lower third of thigh which was soon followed by swelling of right knee joint. Pain increased, especially on manipulation or attempted motion. Has had fever and chills. Is under treatment at present time for acute gonorrheal urethritis.

Examination: Swelling and effusion in right knee joint, local heat, marked muscle spasm, with pain on attempted motion. Temperature 100.5 degrees. Leucocytosis 14,500 WBC.

Operative Notes: September 8, 1926. Aspiration of right knee joint and considerable amount of purulent material obtained. Irrigation with 1 to 4000 acriflavine solution until returned clear.

September 16, 1926. Recurrence of effusion and persistence of temperature. Right knee joint again aspirated and more purulent material obtained, again irrigated with acriflavine solution. Knee joint immobilized and moderate compression bandage applied.

Progress Note: Temperature normal on fifth day and remained normal. No recurrence of effusion, active motion begun.

X-ray: Slight cloudiness of right knee joint with increased density of soft tissues especially well seen in lateral view, extending from patella to the articular margin of the tibia.

Bacteriological Findings: Smear shows no organisms, no gonococci found. Moderate number of pus cells, culture shows no growth.

Present Condition: Complete return of function of right knee joint with no pain. This case is unquestionably a gonococcal purulent arthritis.

CASE 17. J. A., female, aged twenty-four.

Admitted: October 15, 1926, complaining of swollen and painful right knee. Since birth of baby three and one-half months ago right knee has ached and has been moderately painful on motion. Two weeks ago it became swollen and more painful on bending or walking. Had attacks of chills and fever and general malaise.

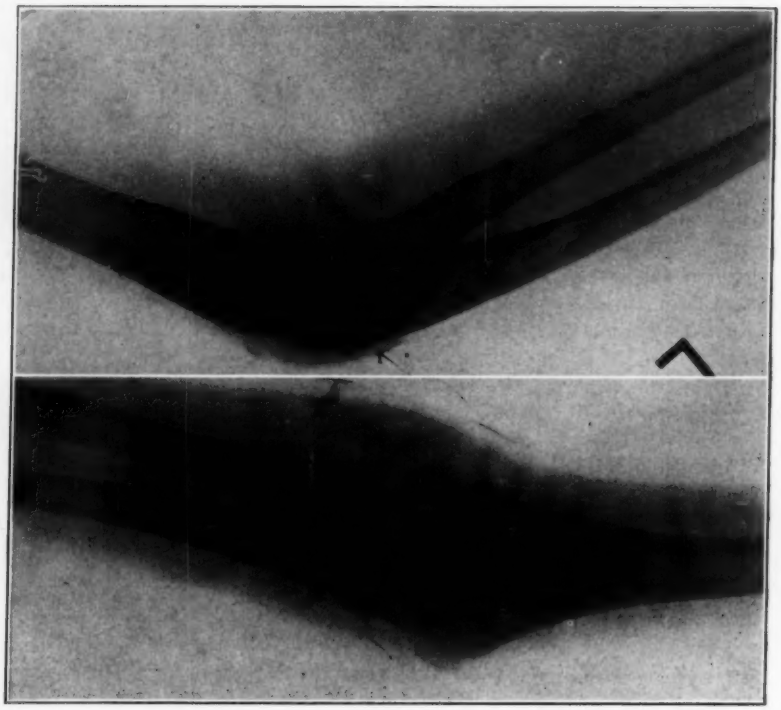

FIG. 19

Case 15. S. A., male, aged eight. Roentgenogram of left elbow joint, illustrating bone change of ulna at elbow joint.

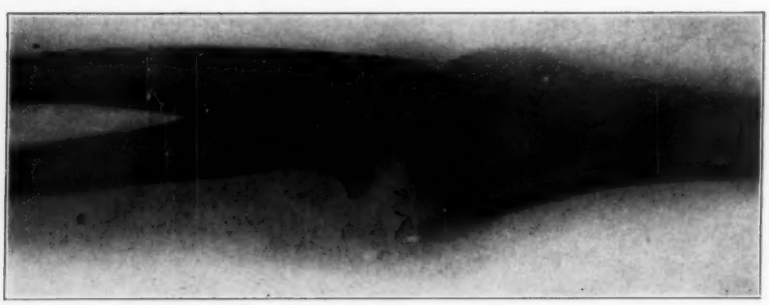

FIG. 20

Case 15. S. A., male, aged eight. Roentgenogram illustrating bone change of lateral condyle of humerus of right elbow joint.

Examination: Elevation of temperature 101.6 degrees, moderate leucocytosis, 12,000 WBC. Right knee is swollen, moderate fluctuation, tender to pressure, moderate local heat, severe pain on attempted motion with muscle spasm.

X-ray: Examination negative for disease of right knee.

Operative Notes: October 16, 1926. Aspiration of right knee joint and large quantity

of seropurulent fluid obtained. Irrigated with 1 to 4,000 acriflavine solution until returned clear. Knee immobilized and compression bandage applied.

Progress Note: Slight elevation of temperature first few days, followed by rapid return to normal. Pain completely subsided, active motion begun, followed by regular course of physiotherapy.

Bacteriological Findings: Culture from knee joint exudate showed no growth, no organisms found on direct smear examination.

Present Condition: Complete return of function of right knee joint.

FIG. 21

Case 18. D. G., male, aged ten. Range of motion of right ankle joint.

CASE 18. D. G., male, aged ten (Figs. 21 and 22).

Admitted: December 19, 1926, to E. N. T. service with history of acute suppurative otitis media and acute tonsilitis, onset December 11, 1926. One day later began to complain of pain in right ankle and immediately afterward in left knee. Were painful on motion. Treated with hot throat irrigations and cleansing of ear. Temperature 99.2 degrees.

Examination: Left elbow. Local heat. Fluctuation over outer and extensor surfaces of left elbow with marked muscle spasm and limitation of motion with pain.

Right ankle. Fluctuation of right ankle anterior to tip of external malleolus. Local heat. Tenderness over astragalus. Limitation of motion and pain in tibia, astragaloid joint. Leucocytosis 12,600 WBC.

X-ray: Right ankle negative for disease. Left elbow shows slight swelling and increased density of periarticular tissues but no roentgen evidence of disease of bones.

Operative Notes: February 21, 1926. Aspiration of left elbow and right ankle and small amount of turbid seropurulent fluid obtained from both, and both joints irrigated with 1 to 4,000 acriflavine solution, and immobilized.

Progress Note: Temperature dropped immediately following aspiration, although did not return completely to normal, probably because of otitis media. Active motion of both joints begun in four days. Discharged from hospital January 15, 1927. Normal range of motion of both joints with no disability.

Bacteriological Findings: Direct smear, small

FIG. 22

Case 18. D. G., male, aged ten. Range of motion of left elbow joint.

gram positive staphylococcus formation. Culture few colonies of thermolytic staphylococcus formation.

CASE 19. M. S., male, aged twenty-six.

Admitted: January 23, 1927, with a complaint of pain and swelling of the left shoulder joint. Three weeks ago, while working at his trade of electrician, twisted his left shoulder. It was only moderately painful for about four days, then he developed fever and chills. There was severe pain in the left shoulder, especially on attempted motion, and motion was markedly limited. Has been under treatment for about six weeks for acute specific urethritis.

Examination: Tenderness over the head of the left humerus with fluctuation over the anterior surface of the shoulder joint. Muscle spasm and almost complete limitation of motion with arm in adducted position. Local heat. Temperature averages 101.6 degrees. Leucocytosis 14,700 WBC.

X-ray: Blurring of joint outlines with widening of interarticular spaces.

Operative Notes: January 23, 1927. Arthrotomy left shoulder joint over anterior surface of shoulder. Considerable amount of seropurulent exudate obtained, together with organized fibrinous material. Dakin's tube sutured into wound and joint cavity irrigated with Dakin solution. Left arm immobilized at angle of ninety degrees in external rotation.

Progress Note: Temperature reduced to normal after six days, following which early active motion was begun, followed by a course of physiotherapy. There is almost complete restoration of joint function. This is probably a gonococcal purulent arthritis.

Bacteriological Findings: Culture and smear, no typical organisms found. Urethral smear, numerous gram negative intracellular diplococci.

CASE 20. L. P., male, aged three.

Admitted: January 24, 1927, with a complaint of pain and swelling of the right wrist and right knee of six days' duration. Has been under the care of the family physician for the last three weeks with an attack of scarlet fever. Six days ago his right wrist began to swell and the following day the right knee became swollen and inflamed. Temperature has averaged 102 degrees.

Examination: Marked swelling and fluctuation, local heat over right wrist joint with complete limitation of motion. Right knee, effusion in joint, local heat and muscle spasm with limitation of motion.

Operative Notes: Arthrotomy of right wrist and considerable amount of purulent exudate obtained. From the right knee obtained serous exudate streaked with purulent material. Both joints irrigated and immobilized.

Bacteriological Findings: No typical organism discovered from smear or cultures.

Present Condition: February 15, 1927. There is complete restoration of motion in right wrist and knee joints.

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THE TENSOR FASCIAE FEMORIS AS A CAUSE OF DEFORMITY

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Deformities following poliomyelitis are frequently due to unopposed muscular action. All muscles have their normal antagonists. A muscle is paralyzed. The action of the antagonistic muscle is unopposed. One of the most prevalent deformities following poliomyelitis is flexion at the hip. This is usually due to unopposed action of the tensor fasciae femoris. Whitman was the first to draw our attention to the infrequent paralysis of the tensor fasciae femoris in cases of poliomyelitis. Flexion at the hip not only causes apparent shortening of the affected lower extremity, but also, it makes it almost impossible for the person so affected to wear any form of stabilizing apparatus.

It is to Dr. C. C. Yount and to his preceptor, Dr. David Silver of Pittsburgh, that our present knowledge of the relief of flexion at the hip joint may be ascribed. Not many years ago Soutter of Boston devised an operation for the relief of flexion at this joint. We have all used this with some success. This operation was a mile-stone on the road of operative advance. It was, however, Yount and Silver who drew our attention to the fact that flexion at the hip joint should be attacked, not about the hip but rather, just above the knee joint where the deep fascia, which may be considered the tendon of the tensor fasciae femoris, can be incised and lengthened. They also suggested[1] that the tensor fasciae might be transplanted into the patella as had already been described by Spitzy in 1914[2].

ANATOMY

We feel that the anatomy of the tensor fasciae femoris has not been appreciated in recent years, although it had been extensively studied by the earlier anatomists, such as Massiat, Duchenne, Manouvrier, Ferrari, Sebatier, von F. Froshe, M. F. Frankel, and others.

The tensor fasciae femoris arises from the anterior part of the outer surface of the crest of the ilium and from the same surface of the anterior superior spinous process and part of the outer border of the notch below it. Its origin lies between that of the gluteus medius externally and the sartorius mesially. It becomes tendinous about five inches from its origin and there blends with the superficial and deep layers of fascia lata and through these receives its bony attachment. Gray says of the latter: "The fascia lata forms a uniform investment for the whole of this region of the limb, but varies in thickness in different parts; thus it is thicker in

the upper and outer part of the thigh, where it receives a fibrous expansion from the gluteus maximus muscle, and the tensor fasciae femoris is inserted between its layers . . . and becomes stronger around the knee, receiving fibrous expansions from the tendon of the biceps externally, from the sartorius internally, and from the quadriceps in front." Externally, the fascia lata receives the greater part of the tendon of insertion of the gluteus maximus and becomes proportionately thickened. The portion of the fascia lata arising from the front part of the crest of the ilium, corresponding to the origin of the tensor fasciae femoris, passes down the outer side of the thigh as two layers, one superficial to and the other beneath this muscle. The deep layer is a continuation of the tendinous fibers of the gluteus maximus muscle and the superficial layer is a continuation of the tendinous fibers of the tensor fasciae femoris, but receives some fibers from the fascia covering the gluteus medius. These layers at the lower end of the muscle become blended into a thick and strong band. This band is continued downward under the name of the iliotibial band, to be inserted into the external tuberosity of the tibia. Attention should be called to the fact that the fascia lata is attached to the femur throughout its length by means of intermuscular septa which arise from it, the outer one being the stronger.[1]

FUNCTION

Professor MacLaren Thompson, sometime Assistant Professor of Anatomy at McGill University, and now of the University of California, was good enough to study the literature on the subject of the tensor fasciae femoris.

The older anatomists had various views regarding it. It was considered a tensor of the fascia lata, an abductor of the thigh, a lateral flexor of the pelvis on the thigh, a flexor of the thigh, a rotator of the thigh, and an extensor of the leg.

It is interesting to note the conclusions arrived at by anatomists on the subject of the function of the tensor fasciae femoris, as outlined by Professor MacLaren Thompson[3].

1. *Tensor of the fascia lata.*

Sebatier thought this to be its most important function.

Manouvrier, however, considers it merely incidental to its other actions, particularly that of medial rotation.

Poirier and Charpy quote Welcker as stating that it acts with the gluteus maximus to prevent the iliotibial tract from slipping off the great trochanter.

2. *Abductor of the thigh.*

This action was practically denied by Winslow and Duchenne, but Manouvrier and most other authors affirm it.

3. *Lateral flexor of the pelvis on the thigh.*

This, which is the converse of thigh abduction, is stated by Manouvrier to be a relatively rare action of the muscle.

4. *Flexor of the thigh.*

Combined with medial rotation, *q.v.*

5. *Forward flexor of pelvis on thigh.*

This, which is the converse of thigh flexion, is stated by Manouvrier to be produced by gravity rather than by any muscle, though possibly under certain circumstances the tensor fasciae latae might do it.

6. *Medial rotator of the thigh.*

Duchenne and Manouvrier have shown that this is an important function of the muscle, by virtue of which it counteracts the tendency of the iliopsoas to produce lateral rotation as well as flexion. In other words, the iliopsoas flexes and rotates laterally, the tensor fasciae latae flexes and rotates medially, and when the two act together (as they do ordinarily) the lateral rotation of the iliopsoas and the medial rotation of the tensor fasciae latae counterbalance each other, resulting in the production of a movement of pure flexion.

This tendency of the tensor to rotate the thigh medially has it structural basis in the observation of Ferrari that some of the fibers of its tendon pass through the lateral intermuscular septum to gain insertion into the lower part of the lateral lip of the linea aspera and into the lateral epicondylic ridge of the femur.

7 *Extensor of the leg.*

Although mentioned by some authors, this action is emphatically denied by Duchenne and Manouvrier.

8. *Flexor of the leg.*

It may have some action of this kind, but I know of no convincing evidence that it does so normally (MacLaren Thompson).

9. *Abductor and lateral rotator of the leg.*

These actions only occur abnormally.

10. *Stabilizor of the leg in extension.*

This is purely a fixation action, not the production of a *movement.* The importance of the tensor fasciae latae in this connection was first realized by Massiat, who got his inspiration (but not this particular idea) from Leonardo de Vinci.

Massiat showed that this function has its structural basis in the fact that the tendinous fibers of the muscle preserve their identity in the fascia lata, descending as a distinct band (the bandelette de Massiat) to the lateral condyle of the tibia. A few fibers are said to be attached to the patella.

DEFORMITIES

There are certain deformities due to unopposed action of the tensor fasciae femoris. All of these deformities owe their origin to paralysis or pareses of those muscles which normally act as opponents to its various functions.

Yount, speaking of these deformities, says, "There are certain deformities which are frequently seen in conjunction with hip flexion con-

traction. The one occurring most frequently is undoubtedly knee flexion contraction. The most important etiologic factor in the development of this deformity is, of course, paralysis of the quadriceps extensor. . . . A deformity frequently seen associated with hip flexion is that chiefly described as knock-knee."

My associates in Montreal consider that the deformities due to unopposed action of the tensor fasciae femoris are five in number — indeed, we always classify them together and speak of the "pentad deformity" due to unopposed action of the tensor fasciae femoris. Of these five deformities we have the three deformities already mentioned by Yount and commonly a fourth, *viz.*, eversion of the leg. Besides this fourth we have, but not commonly, inversion of the thigh. This latter, when present, is due to the attachment of the tensor fasciae femoris to the linea aspera of the femur through the attachments of the iliotibial band to the intermuscular septa.

TREATMENT

The deformities due to unopposed action of the tensor fasciae femoris, in the opinion of the writer, are best treated by a transplantation.

It is true that Yount first practised a fasciotomy of the deep fascia of the thigh to relieve the deformities due to this condition. It is true that this operation was a distinct advance on the operation originally planned by Soutter.

Whenever possible, transplantation of tendons has been the practice of my associates in preference to either lengthening a tendon or fascia. Thus it was natural, that while we accepted the work of Yount and his preceptor, Silver of Pittsburgh, we felt that the tensor fasciae latae should be transplanted instead of lengthened. We suggested this and practised this because of the principles so often enunciated in our clinics that tendon transplantation should be carried out to convert a positive power for evil into a power for possible good. When thus enunciating this principle we always explain, that while we hope that a transplanted muscle may take the place of a paralyzed muscle, we must not expect too much. We must not expect a muscle of but little power to take the place of a muscle of the greatest power.

After publishing our original article in the *Journal of Bone and Joint Surgery*[4], Dr. Yount drew our attention to the fact that Spitzy in 1914 had advocated the operation practised by us. Further, Yount drew our attention to the fact that in his third reported case a strip of fascia lata, including a portion of the vastus externus, was transplanted to the center of the thigh and fixed to the patella, as previously described by Spitzy. He said that sufficient time had not elapsed to estimate the value of the tenoplastic procedure. We, for our part, have amply demonstrated the advantages of this operative procedure of a transplantation of the tensor fasciae femoris into the patella, and it is one of the operations commonly performed in the orthopaedic services of my associates.

THE OPERATION

First we endeavor to delineate the tensor fasciae femoris and those parts of the fascia lata which are contracted. This we do by extending the thigh and adducting it as well as internally rotating the leg. This must be done while the other lower extremity is held in position of a Thomas flexion.

We then make a long incision from as near as possible to the anterior superior spine, downwards over these contracted fibers to a point just posterior to the outer side of the patella. Then we carry this backwards to the outer surface of the upper part of the tibia. The contracted fibers of the tensor fascia and the fascia lata having been exposed, either a long ribbon-like portion, which includes the contracted fibers of the deep fascia, is separated, or a broad fan-shaped section of the fascia lata is separated from the surrounding parts, as suggested by Yount. This fan-shaped section is taken from the lateral and posterior surface of the thigh. The dissection extends upwards to the lower edge of that portion of the gluteus maximus which is inserted into the fascia lata, and downwards to the attachment of the fascia lata into the outer surface of the tibia.

This section of the fascia lata is then rolled into a tube of about the size of a large pencil so that the muscular surface forms the outer surface and the subcutaneous surface forms the inner surface of this tube. This is then fixed in its tube-like form with a continuous suture of catgut.

A longitudinal incision is then made over the center of the patella, down through the periosteum to the bone.

A long pair of forceps is then passed upwards through the superficial tissues from this incision over the patella to that incision exposing the tube-like band of fascia lata already fashioned. This tube of fascia lata is now pulled downwards and forwards to the anterior surface of the patella and united to that bone under the periosteum.

All incisions are then dealt with, the wounds dressed and the patient's lower extremity placed in a plaster-of-Paris spica, which maintains the affected thigh in extension and the knee also in extension as well as guarding as far as possible any other deformities which may obtain.

CONCLUSION

The study of the tensor fasciae femoris is of importance. It is well to recognize that not only flexion at the hip but several other deformities may be due to unopposed action of this muscle.

While tenotomies and fasciotomies have undoubtedly their place amongst recognized surgical procedures, in the majority of cases a transplantation is to be preferred. As has been taught, transplantations are often carried out to convert powers for positive evil into powers for possible good.

The studies of hip and knee flexion carried out in our clinics have been made by Doctors H. Rupert Derome, C. M. Kirk, and R. Breitman, acting in conjunction with the writer.

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GRADUAL REDUCTION OF CONGENITAL ANTERIORLY DISLOCATED KNEES

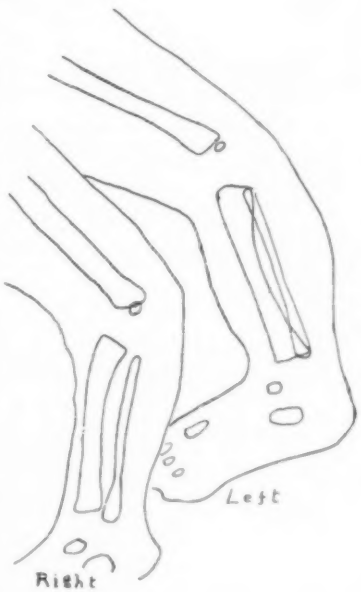
BY EDWARD T. WENTWORTH, M.D., ROCHESTER, N. Y.

The following case report is of interest, because of the extreme dislocation of both knees and the conservative treatment which effected reduction.

W. W.: First seen November 11, 1927, when five days old. History of breech presentation and delivery without instrumentation. Since birth, both knees have been bent convexly backward. Child has never been observed to move the legs at the knees.

Well developed and nourished baby. Right arm held in internal rotation, elbow in extension, forearm in pronation. Under observation there was no evidence of arm abduction or external rotation or of forearm supination.

Both knees were held in hyperextension. Hamstrings responded to irritation by contraction, but were unable to function because of motion being blocked at knees. Femoral condyles fully palpable in popliteal spaces. Upper ends of tibiae displaced anteriorly. Marked lateral instability of knees. Quadriceps both so short that reduction of dislocation at the knees was impossible without force.



Film showed normal hips, but anterior dislocation of legs at knees, as per tracing herewith.

It would appear that intra-uterine life was spent with hips in full flexion and legs in extension. Inasmuch as pressure by the uterine wall was not counteracted by pressure on the fronts of the legs, they had grown in an anteriorly dislocated position at the knees.

Believing that reduction of the dislocation by force would be accompanied by possible trauma to epiphyses, in the same way as in difficult reduction of congenitally dislocated hips, recourse was made to slow flexible traction in the line of deformity, by means of an improvised double traction splint made with wire and padded. Traction was applied to the legs below the knees, and carried through rubber bands to the splints; countertraction, by means of padded wire peroneal pieces attached to splint. This permitted easy care of the child and gradual increase in the amount of flexion.

The right arm was put up in ninety degrees abduction and full external rotation, with the forearm in full supination, on a regular brachial palsy splint.

November 21, it was possible to start flexion of the left knee. This was done by bending the wire side pieces of the splint. Traction was maintained. There was still so much quadriceps resistance in the right leg that it was impossible to do anything by way of reduction. The amount of traction was increased on the right leg.

November 26, the left knee could be readily flexed to 140 degrees. The right knee

could be barely reduced, but no more than five degrees flexion could be readily obtained.

December 1, the left knee could be readily flexed to 110 degrees and the right knee to 140 degrees.

December 6, both knees could be readily flexed to ninety degrees. It took no pressure to maintain them at ninety degrees, but extension was not entirely complete. The lower extremities were encased in plaster-of-Paris with the knees at ninety degrees.

January 4, 1928, plaster was removed. The knees, apparently, were in normal position and presented free motion between ninety and 180 degrees. Motion was also under control. No protection was given.

January 11, knee action was free between eighty and 180 degrees without spasm or crepitation. Function of the upper right extremity had also returned to normal.

The actual reduction was spontaneous when traction overcame quadriceps shortening. No trauma and no anaesthetic needed.

CARTILAGE INJURIES

A Clinical Study

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In the July issue of the Journal of Bone and Joint Surgery for the year 1926 (VIII, 651), under the title of "Introductory Considerations in the Study of Cartilage Injuries," a few of the more practical anatomical, chemical, and pathological aspects of cartilage injuries were considered. With the preceding facts, a few of the more frequent conditions involving cartilage may now be discussed.

FINGERS

Dense fibrous areas are to be found at the distal ends of the phalanges, with the exception of the terminal tufts. These areas are located on the lateral surfaces of the phalanges and communicate directly with the hyaline cartilage covering the bone ends. Among these fibrous bodies may be found cartilage cells which extend upward along the shaft beyond the limits of the finger joints. The tissues in this locality take a great part in the formation of the appearance of the fingers, and injury to them often causes an unsightly deformity which may be accompanied by a small amount of disability, in that the finger cannot be completely extended, and is thus held in a slightly flexed position. The relation of the phalangeal joint cavity to these fibrous and cartilaginous structures may be seen in the accompanying illustration, which was made by injecting the joint cavity with oxygen. It will be noted that there are no lateral extensions, but there are two bursae (as it were) extending on the dorsal and ventral surfaces of the bone which forms the proximal part of the articulation (See Fig. 1).

When a direct blow is received over the areas just described, the cartilage and fibrous tissues begin very soon, often within a few days, to hypertrophy, and within a week a very dense fusiform swelling is noted. Often a fracture is suspected. X-ray examination, however, fails to reveal any bone pathology, unless there is observed a shadow corresponding to these areas. A patient seen after a recent trauma of this nature should not be dismissed (as often is done) by informing him that "no treatment is required". It seems clear that vigorous massage will lessen the hypertrophy, and thus prevent to some extent at least, a permanent deformity. This matter has been considered with the Department of Physiotherapy and although we are unable to report a series of such cases, there are outstanding examples which lead to the above opinion. Immobilization will

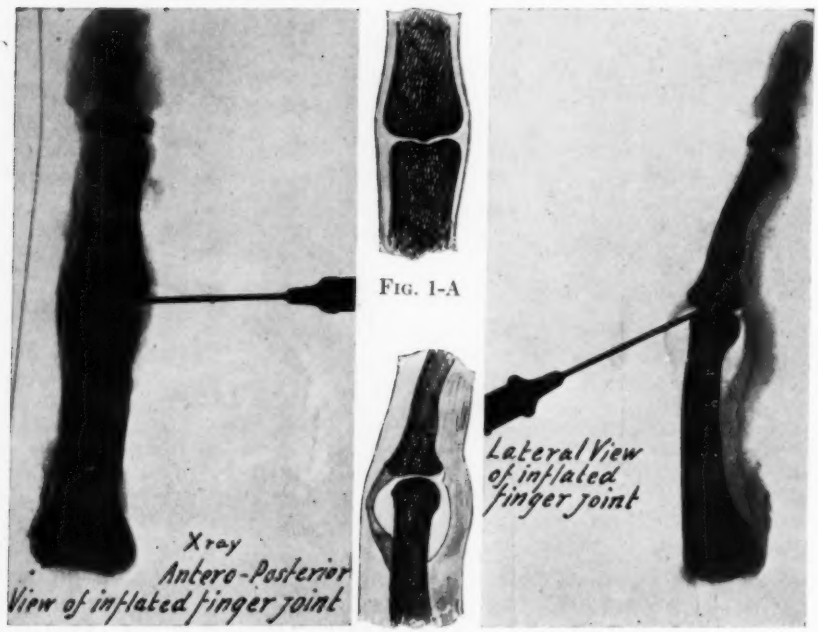


Fig. 1-A

Fig. 1-A Fig. 1-B Fig. 1-B

Fig. 1-A. X-ray and drawing, anteroposterior view of inflated finger joint.
Fig. 1-B. X-ray and drawing, lateral view of inflated finger joint.

probably not in any way prevent such a deformity. After the condition has existed for more than one month, it seems unlikely that any treatment will prove beneficial. In patients where the appearance of the fingers is of great importance, for example those of a musician, it will be apparent at once how imperative it is to begin prompt treatment as soon as the condition is recognized.

Not infrequently cases are seen several weeks after the original injury, and present themselves largely because of the deformity. In workingmen, however, the writer has not encountered a single case where the condition became a source of permanent disability, and the tenderness noted in the acute stage is rarely complained of after a period of from two to four weeks.

Cartilaginous conditions accompanying finger infections are of considerable interest, particularly where there is present an osteomyelitis requiring the removal of a diseased bone. It is to be remembered that the epiphysis of the phalanx is always located at the proximal end of the bone. The epiphyses of the metacarpal bones (with the exception of the thumb) are at the distal end of the shaft. The epiphyses of the phalanges are said to unite about the twentieth year (See Fig. 2).

With these facts in mind, in removing a diseased bone, care should be exercised not to allow the epiphysis to remain. At operation it appears very much like the scale of a fish, both in size, shape, color, and consistency.

FIG. 2

Normal hand of an adult eighteen years of age.

It should be removed completely, without injuring the articular surface of an undiseased bone forming a part of the same joint.

It is interesting to note that finger infections involving primarily a joint, produce a swelling on the dorsal, and on the palmar surface of the finger. The presence of the flexor tendons, however, largely prevents a recognition of the latter. On the other hand, as has been said, if the swelling is most prominent on the lateral surface of the joint, and not apparent on the dorsal surface, the condition is one involving the fibrous areas, described at the beginning of this article.

Articular cartilage is resistant to infection, and is often not severely affected if the proper drainage of the joint is carried out in the early stages of the disease. A distinct "joint crepitus" may be felt as the articular surfaces rub together, but this is no indication for immobilization and motion should be kept up constantly in an infected finger joint. All of these facts are well known and taken into consideration where larger joints are concerned, but in the fingers they are often overlooked, and an ankylosis is allowed to develop.

Direct injury to the articular cartilage of the finger joint is rarely encountered. Recently the writer operated upon a carpenter who cut into the finger joint with his saw, and destroyed a considerable portion of the cartilage. In operation no attempt was made to remove this tissue. The capsule of the joint was repaired with great difficulty, the extensor tendon sutured. The finger was placed in a splint for ten days and the end result showed a very slight loss in the function of the joint.

Prolonged immobilization of the finger joints does not necessarily cause any marked changes in the articular cartilage. The author recently operated upon a navigator who, pulling in his log rope, infected and lost a considerable portion of the palmar surface of his index finger. He was at sea for many weeks and the finger had been ankylosed for nearly a year, when he was first seen. (Aside from being a mariner, he was also an accomplished violinist.) The flexor tendons were lengthened. A plastic flap of skin and subcutaneous fat was grafted from his back and the end result showed that the motion of the finger joints had not been greatly interfered with as the result of their prolonged immobilization.

NOTE: In connection with industrial conditions (for example in New York State) there is what is called a "healing period." It should be remembered that in attempting to treat cartilaginous finger injuries and also other finger conditions, one should not exceed this period unless it is strongly indicated. Also that a loss in motion of a finger joint is as great a loss to the employer or insurance carrier, as an amputation of the finger

at the ankylosed joint, and if the "healing period" is likely to exceed the scheduled loss placed upon the different fingers, from the standpoint of the employer or insurance carrier, an amputation is more desirable than a prolonged period of disability.

In regard to chondromas which are often seen in the fingers, but which in reality is a very rare condition, they are usually found in children or young adults and are thought to be closely associated with epiphyseal development. They are said to be frequently associated with rickets. These tumors, which are encapsulated, may be found on the lateral surface of the finger near the joint, but remembering what has been said regarding the epiphyseal line, it seems unlikely that such a swelling could be confused with a hypertrophy of the fibrous bodies, which are located at the lateral surface of the joint on the distal portion of the bone while the epiphyses are located on the proximal end of the phalanges.

WRISTS

At the wrist joint will be found a very important triangular fibrocartilage which is located at the lower extremity of the ulna. It is of an equilateral triangular shape and measures about one-half inch in length along the border and about one-quarter of an inch in thickness. It is firmly attached to the radius and to the ulna and performs a double function in that it binds the two bones together and also completes the arch for the proper articulation of the carpal bones. It is this dense fibrous body which is responsible for the tearing off of the ulnar styloid as frequently seen in Colles' fracture. There is a separate joint cavity above and below this structure as will be noted in the accompanying illustration (Fig. 3). Although this cartilage is described in text-books on anatomy, I personally found that I did not have a clear conception of this structure until it was photographed in the manner illustrated

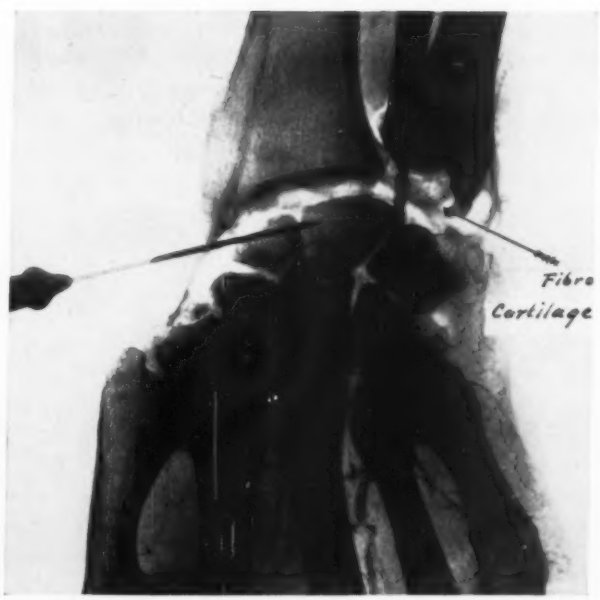
The location of this cartilage protects it from direct injury, but it is frequently damaged indirectly, as has been said, in Colles' fracture, and is partly responsible for a deformity occurring in the region of the ulnar styloid. This was noted in a series of cases reported by Dr. Ritter and the writer.[1]

The author has never attempted to remove this triangular cartilage, but recently had a case in which there was a tuberculosis involving the carpal bones. These bones were completely removed and with them the diseased cartilage. An ankylosis was produced. The operation was done nearly a year ago. The patient has been seen recently and apparently there is no recurrence.

In fractures involving the radial scaphoid, if this bone is removed, there apparently is no resulting interference with the function, and no tendency to affect the cartilage which forms part of the arch for articulation with these bones.

The writer recently operated upon a young man who completely tore away the lower end of the ulna, as a result of an accident received while

Drawing



X-ray

FIG. 3

Illustration of normal hand. X.—Triangular fibrocartilage in wrist. Note: There is also an old fracture of the radial scaphoid which was accidentally found in the preparation of this specimen.

cranking a truck. The lower fragment was notched into the upper shaft and sutured with kangaroo tendon. At the operation free motion in the lower fragment was noted, indicating that the triangular fibrocartilage must have been completely torn from its attachment, but at the time it did not seem wise to attempt in any way to fix the repaired ulna to the radius, and the cartilage itself was not well exposed.

There is a closely related condition which is seen at the wrist, and may well be discussed in an article dealing with cartilage injuries, *i.e., ganglion.* This is what might be called a blowout of the joint capsule, between one of the small carpal bones. Such swellings will be found to contain a thickened jellified synovial fluid, which can rarely be aspirated. If they are struck with a heavy book or padded mallet, so as to rupture the joint capsule, and are then tightly bandaged for a period of two to three weeks, often the condition does not recur.

Some time ago, the writer operated upon a ganglion of the wrist in a young man who had devoted fourteen years of his life to the study of the piano. It is very difficult to close these joint cavities, because of the close proximity of the carpal bones. In this case, there was a slight seepage of synovial fluid, but apparently dense fibrous tissue finally closed the opening, and the wound healed favorably. As far as the case was followed, the end result was satisfactory, but it is much better to attempt to break these ganglia, as stated above, and not to operate unless several attempts by the closed method have been unsuccessful.

In a recent edition of the Archives of Surgery[2], Dr. Jaffe and Dr. Zadek have reported finding a cyst within the fibrocartilage of the knee. There seemed to be in this cyst some remnants of synovial membrane. It is possible that these cysts may occur in other fibrocartilages, and may be

FIG. 4-A
Condition before operation.

FIG. 4-B

FIG. 5
Condition following operation.

the cause of a swelling at the wrist. It must be said that once a cartilage cell has fully developed, an injury to this cell will not cause it to hypertrophy, and it is only the partially developed cells which take on new activity.[3] Also that the perichondrium is largely responsible for the hypertrophy, as seen in hyaline cartilage, but it is difficult to explain such an hypertrophy in a fibrocartilage as that found in the wrist joint in an adult where the cartilage cells are probably largely fully developed. The damage to the fibrous tissue surrounding this structure would readily hypertrophy and might take on cartilaginous changes which would explain these deformities which are seen at the wrist joint.

SUMMARY

1. Injury to cartilage results in a proliferation (not of the adult cartilage cells) but of the partially developed cells and surrounding fibrous and connective tissue.

2. The chemical changes accompanying such condition deserve more extensive study.

3. Injuries about the finger joints often lead to permanent deformities and may be amenable to treatment.

4. The differential diagnosis between joint infections and fibrocartilaginous injuries is usually not difficult.

5. The triangular fibrocartilage of the wrist is of importance in injuries in and about this area.

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CONGENITAL DISLOCATION OF THE HIP; THE EFFECT OF ANTERIOR DISTORTION; A PROCEDURE FOR ITS CORRECTION*

BY ARTHUR KRIDA, M.D., F.A.C.S., NEW YORK

From Hospital for Ruptured and Crippled

DEFINITION OF TERMS

Luxation		=	Dislocation
Reduction Replacement	(Lorenz)	=	Reduction
Retention	"	=	Fixation
Reluxation	"	=	Redislocation
Anterior Transposition	"	=	Anterior Dislocation
Anteversion plus Anterior Torsion		=	Anterior Distortion
Derotation Detorsion Detorquierung		=	Detorsion

The designation of detorsion as preliminary, simultaneous, intermediate, and late, refers to the time of the reduction of the dislocation.

The terms indicated on the left are those which are frequently encountered in the German literature, those on the right are the corresponding designations used in this paper.

INTRODUCTION

Despite the optimistic tone of the great volume of literature on the closed method of treatment of congenital dislocation of the hip, recent end result studies[1,2] demonstrate that the results of such treatment are much poorer than might have been anticipated. In the absence of direct visualization of the precise pathology present in these joints at the time of operation, the proximate and ultimate causes of such failure must, to some extent, remain matters of inference and deduction. It seems however to be quite generally agreed that a common, and probably the most common, cause of relapse is a torsion-distortion of the upper end of the femur.

The theory upon which the treatment of congenital dislocation of the hip is based is that a more or less abnormal femoral head is replaced into or in contact with a more or less abnormal acetabulum, and maintained there by fixation dressings until mutually adaptive changes occur in these structures, sufficient in degree to assure security in the articulation.

It must be evident, therefore, that the greater the incongruity of the joint elements which it is proposed to reassemble, the less is the chance of

*Presented at Annual Meeting of Alumni Association, Hospital for Ruptured and Crippled, November 1927.

such mutual adaptation taking place. Conversely, the dislocated hip loses its stimulus to normal growth and development, and the longer ambulation in the presence of a dislocation goes on, the greater must be the secondary changes in the hip joint structures. It follows, therefore, that treatment should be undertaken as soon as the condition is recognized, which, in general, will not occur until ambulation begins. The favorable period for treatment by the closed method may be considered to terminate at the age of three, which allows, on the average, a period of ambulation surely long enough for the diagnosis to become evident, a period of over one year. Cases reporting for primary treatment after this age should not be made the basis for the evaluation of a treatment, but should be looked upon as examples of professional or parental neglect, in which, in general, and by any method of treatment, only a partial result or total failure is to be anticipated.

THE EFFECT OF ANTERIOR DISTORTION; HISTORICAL ASPECTS OF ITS TREATMENT

The normal forward inclination of the head and neck of the adult femur varies, according to anatomical text-books, between six degrees and fourteen degrees. Durham[3] examined 220 specimens in the Anatomical Museum of the College of Physicians and Surgeons of Columbia University, and found an average of twelve degrees. Braus[4] states that variations up to thirty-five degrees may be looked upon as individual peculiarities without pathologic or evolutionary significance.

Normal conditions in the infantile femur would appear to be somewhat different. La Damany, cited by Lorenz[5], states that from the fifth month of intra-uterine life until birth, he found from thirty to fifty degrees of forward inclination. After birth up to two years he found a retrogression of the angle to an average of thirty-five degrees. According to Pitzen, cited by Schultz[6], the two and one-half year old femur presents an anteversion of from twenty-two to thirty-three degrees, which diminishes with subsequent growth.

More pronounced degrees of anterior torsion are frequently found in congenital dislocation of the hip, and here the distortion has a distinct pathologic significance. It is an acquired distortion in the sense that it represents partly the persistence of the anteversion normal to the age, and partly, its further development by the contact of the dislocated head with the side of the ilium during ambulation. The struggle for stability during the early phases of ambulation forces the dislocated head towards bony contact with the side of the ilium, sometimes to a degree sufficient to produce a secondary acetabulum, by constantly attempted inward rotation of the outwardly rotated extremity. The plastic infantile femur is incapable of fully withstanding this rotatory stress, and consequently develops a torsion deformity. Should the head lose its precarious contact with the lateral wall of the ilium, and become displaced far posteriorly, this distorting force ceases its action.

As above stated, nearly all observers who have had a large experience in the treatment of congenital dislocation of the hip, recognize the inimical influence of this distortion upon the ultimate security of the joint. Lorenz[7] states the case as follows: "Whenever we sought for the causes of reluxations in replaced hips, we found that, as a rule, a marked degree of antetorsion forced itself into the foreground as the proximate cause".

According to Bade[8], Schede (1897), was the first to recognize the situation, and to propose a definitive treatment therefor. His method was to reduce the dislocation, fix the hip for three months, and then perform a subtrochanteric osteotomy, fixing the upper fragment by a long nail, against which the lower fragment was rotated through a suitable arc. The whole, including the nail *in situ*, was fixed in plaster in the corrected attitude.

Galleazi[9] in 1910, described the following procedure: Reduction and fixation in prolonged inward rotation until balance between the external and internal rotators of the hip has been secured; and a relatively stable relationship between the head and acetabulum has developed. The limb is then freed for several days. If the hip then shows no tendency to redislocation, but maintains the degree of inward rotation which was purposely given to it, and which corresponds to the concentric attitude of the head, he proceeds to detorsion. A pressure pad with a bolt and nut mechanism is then applied to the trochanteric region, which is incorporated in a short spica. A window is cut anteriorly for observation of the head. One assistant steadies the head through the window, a second grasps the shaft, the operator grasps the condyles with one hand and the leg with the other. Then by using the leg as a lever, mild and gentle detorsion movements are made. Apparently a total fracture is not produced. Then follows a traction period of thirty days, during which pressure on the trochanter is maintained.

Palagi[10] (1913), reporting twenty-six cases, states that "grave distortions are treated by supracondylar osteotomy", but further details of the method are not described.

Reiner[11] (1910) proceeded to a preliminary supracondylar osteotomy for cases of marked anteversion, and reduced the dislocation after three months.

Hibbs[12] (1915) reported a similar procedure, which he employed in twenty-nine cases with satisfactory results. Lorenz[13] elaborated the procedure into a "simultaneous detorsion", by reducing the hip and at the same time correcting the torsion deformity. The procedure seems to have been discontinued by Lorenz himself.

Froelich[14] (1921) performed late osteoclasis in the following manner: after a suitable period of fixation in the necessary degree of internal rotation, the lower portion of the spica is removed at the level of the lower third of the thigh. The femur is then fractured manually over the end of the plaster spica, and the lower fragment rotated outward.

Brandes[15] described what may be termed an intermediate detorsion.

FIG. 1

The usual attitude in the pre-operative x-ray, patella in the sagittal plane. Head and neck appear shortened due to the anterior distortion.

He applied it first in ten cases that had become redislocated following the routine period of fixation. In a later communication[16] (1924) he states that he uses it in all cases of pronounced anteversion. His procedure is as follows: reduction and fixation in the ninety-ninety position; after six weeks, manual supracondylar osteoclasis with outward rotation of the lower fragment through an arc commensurate with the calculated anteversion present; fixation with the knee flexed at ninety degrees, the leg pointing upward, and the upper end of the femur in the original ninety-ninety position. Later, graduated descent of the extremity.

THE DETERMINATION OF ANTERIOR DISTORTION

The estimation of the degree of anterior distortion present in a given case must be a matter of individual interpretation, since the nature of the problem is such that mathematical standards can but imperfectly be applied to it. The two factors which have been of use to the writer are

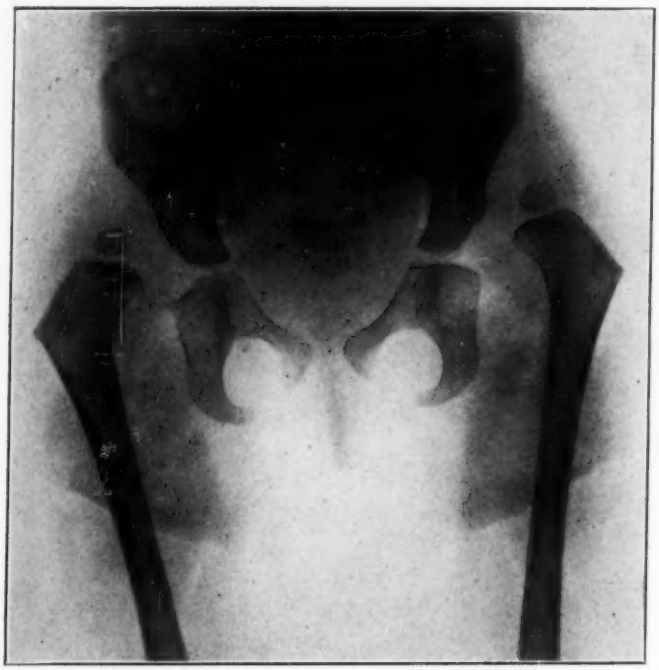

FIG. 2

The same hips, with the extremities rotated inwardly. Note the demonstration of an adequate neck and head.

the x-ray, correlated with palpation of the head of the femur at the time of the first change of plaster following reduction.

Drehman's[17] x-ray demonstration of anterior distortion consists in making two exposures of the unreduced dislocation under standardized conditions. The first exposure is made with the patella directed sagitally, the second with the extremity rotated inward. The second exposure will show more neck and head than the first; the greater the discrepancy between the two films, the greater is the degree of anterior distortion which may be inferred to be present.

The correlative factor of the behavior of the femoral head at the time of the first change of plaster following reduction is, in the writer's estimation, a factor of greater import. If the ninety-ninety attitude be adopted for the original dressing at the time of reduction (which the writer believes to be desirable), the relationship of the femoral head to its proper position in the acetabulum may be fairly satisfactorily determined at the first change of plaster two weeks later. If upon lessening the abduction and rotating outward to a moderate degree, the head is felt very superficially or slightly laterally, it may be inferred that a degree of anterior distortion exists which is inimical to the ultimate security of the joint.

The incidence of anterior distortion determined in this manner is higher than might be gathered from previously published experience. Reiner[11] estimated it at fifteen per cent.; Froelich[14] found only one per cent. which demanded a definitive treatment. The writer's evaluation of the influence of this distortion has been influenced by the following considerations:

(a) Since redislocation following removal of fixation dressings is always anterolateral, a deeply placed head assures a greater margin of reserve than one situated superficially in the groin.

(b) In order to secure a deep position of the head in the course of fixation treatment, it is necessary to adopt a position of more or less internal rotation of the extremity. The precise relations of the head at the time of reduction cannot be adequately determined on account of the thickness of the overlying soft parts. Primary fixation in internal rotation is therefore inadvisable.

(c) The determination of the precise relations of the femoral head must be made before the bones have become softened by immobilization, in order that any rotatory force applied to the extremity may be exerted wholly in actual effect upon the relations of the head, rather than being in part dissipated in rotatory distortion of the shaft of the femur and of the limb segments below it.

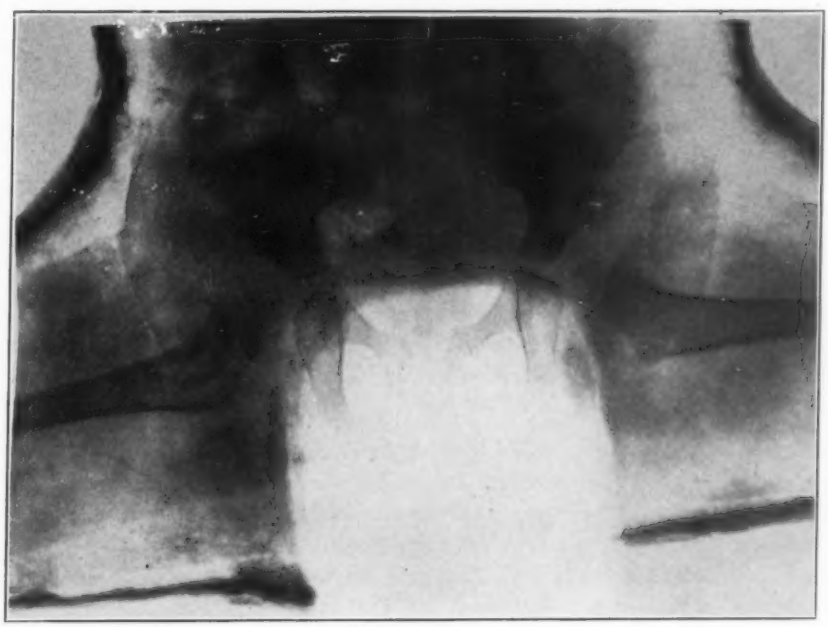

FIG. 3

The first attitude in plaster.

(d) If such a determination be made within two weeks of the primary reduction, a surprisingly large number of cases will be demonstrated, in which the head of the femur lies very superficially in the groin upon even moderate lessening of abduction and slight external rotation.

(e) Since the habitual attitude of all cases of congenital dislocation when beginning ambulation upon the removal of fixation dressings is one of rather marked external rotation, it must be evident that this attitude will tend to lever the head forward and laterally.

(f) The inimical influence of this attitude may be minimized or entirely combated by anticipating it, and by rotating the lower limb segments outward, while at the same time maintaining the inwardly rotated and deep position of the femoral head. This is accomplished by a solution of continuity in the supracondylar region, and suitable outward rotation of the lower segment.

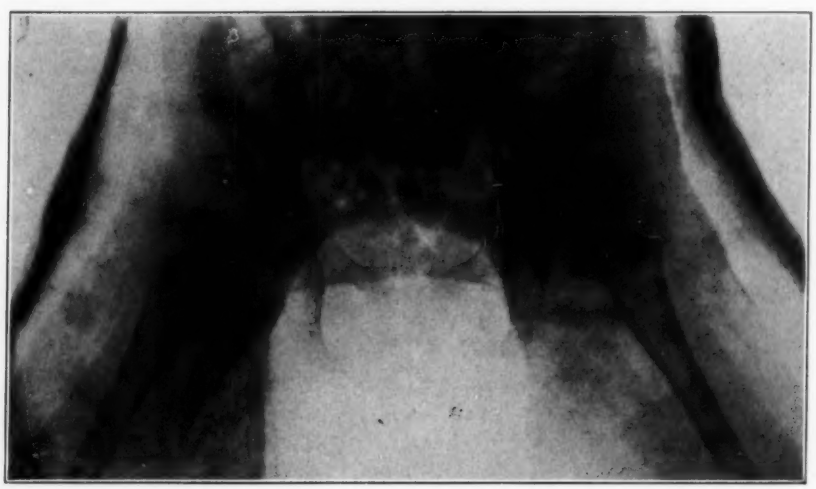

FIG. 4

The second attitude in plaster, the lower extremities are inwardly rotated to a degree sufficient to overcome the anterior distortion.

MANUAL OSTEOCLASIS

The considerations above outlined have primarily, and the historical aspects only secondarily, and as it were *post hoc*, induced the writer to adopt the modification of procedure outlined below. The results within the present limits of observation have been wholly satisfactory. Of twenty-eight hips treated, in nine the correction of the internal rotation as outlined below was carried out.* The procedure has been used as a routine of treatment in the work of the First Division at this hospital, during the last two and one-half years.

*Since the compilation of the above report ten further hips have had this procedure done.

FIG. 5

After removal of fixation dressings, showing the sites of fracture in the supracondylar region, and the satisfactory relations of the femoral heads.

PROCEDURE

1. Reduction "*aus freier hand*", over the posterior rim of the acetabulum, preceded by suitable stretching of the adductor origins. Fixation in the ninety-ninety position. X-rays after reduction.

2. Two weeks later, adoption of what may be called the definitive position. Evaluation of the conformation of the upper part of the femur by a study of the x-rays, but particularly by palpation of the precise position of the femoral head in the groin. If no abnormal anterior distortion can be determined, fixation in mild internal rotation and lessened abduction. If abnormal anterior distortion is determined to be present, fixation in a degree of internal rotation sufficient to entirely overcome it. For anterior distortion cases, non-ambulatory fixation dressing for three months.

3. For anterior distortion cases, correction of the internal rotation

FIG. 6

FIG. 7

FIG. 8

FIG. 9

FIG. 6. The attitude of the extremity upon removal of the second plaster.
FIG. 7. Manual osteoclasis. The femur is fractured in the supracondylar region.
FIG. 8. The correction of the rotation. The right hand grasps the head and neck, and the left hand rotates the lower fragment outward.
FIG. 9. Correction completed.

imposed upon the extremity in the second sitting, in approximately three months from the beginning of treatment, by manual fracture of the femur in the supracondylar region and by suitable outward rotation of the lower fragment. At this point, the lower extremity lies on the table on its inner aspect and there is no need to fix the hip joint in any manner. The supracondylar region is grasped by both hands and a fracture is easily made in the supracondylar region. One hand then fixes the head of the femur in its original position; the other hand rotates the lower fragment outward until the patella lies in the sagittal plane, or somewhat beyond it. Fixation in moderate abduction, slight flexion at the hip, and moderate flexion at the knee, sufficient in degree to maintain the rotated position of the fragments. After six weeks, for unilateral cases, a simple spica bandage for ambulation; for bilateral cases, a longer period of fixation, followed by a period of rest in bed with massage, active joint mobilization, and rest and sleep in a plaster bed.

FIG. 10

Plaster-of-Paris applied in the corrected attitude. Hip and knee each slightly flexed.

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THE TREATMENT OF INFECTED WOUNDS WITHOUT SUTURES, DRAINAGE TUBES OR ANTISEPTIC DRESSINGS*

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Various conclusions have been held out to us as the surgical lessons of the World War. The principal of these are perhaps the Carrel-Dakin method for the treatment of infected wounds, the mobilization of joints in the vicinity of or involved in compound fractures, and the primary and secondary closure of contaminated or actually infected wounds.

We have been told that the continuous irrigation of septic wounds is necessary and the only effective manner of dealing with wounds in which infection has become established. We have also been told that the immobilization of fractures is not only unnecessary but undesirable, and finally that the primary closure of a compound fracture is a suitable method for a considerable percentage of such cases.

Wound infections occur in three ways: first, at the time of injury, second, at the time of primary treatment, and third, at the time of secondary treatment or surgical dressing. We may have, of course, in any case an amount of injury or an amount of primary infection which from the standpoint of wound treatment renders the case a hopeless one from the start. Either the trauma or the infection may be so severe that the life of the patient is destroyed at once or soon. Such patients it is hardly worth while to discuss from the standpoint of wound treatment. Even the primary infections, however, obviously depend for their effects to some extent upon the damage to the tissues as well as upon the amount of infection introduced. That these primarily infected cases are not always so severe as we have been accustomed to think is quite evident from two facts:—first of all, we have been doing successful primary closures in wounds that would formerly have suppurated, and, in the next place, we have found that it is possible by thorough debridement to render a certain number of such wounds suitable for primary closure.

A great difficulty arises in the selection of patients for primary closure either before or after debridement. We have absolutely no constant factor upon which to decide whether or not a primary closure may properly be attempted. In consequence the results of primary closure vary according to the severity of the injury, the amount of infection, and the skill and judgment of the surgeon. For that reason it has proved to be quite unsafe to recommend primary closure as a measure for general adoption.

In the second group of such cases we have those which become infected as a result of the primary treatment. The number of cases in this group is much larger than we have been accustomed to think and it is to this

*Read before the American Orthopaedic Association, May 3, 1928, Washington, D.C.

group and to the next that I wish to apply myself particularly in this discussion.

For such a purpose, it is necessary for us to alter our attitude toward wound infections somewhat. It is not customary to say—"This was a primarily clean wound but it became infected at the time when I sutured it and put in a drainage tube". That such infections are of frequent occurrence, however, cannot be doubted.

We may assume that a considerable number of cases in days gone by might have been closed by primary suture successfully but became infected on account of traumatism or actual additional infection in the course of suturing, insertion of drainage tubes, the application of dressings, etc.

Two factors of great importance in the origin and development of such infections are our entirely improper reliance upon so called antiseptic solutions for hands, instruments, and wound cleansing and the additional trauma inflicted by handling, instruments, and sutures. Unfortunately, we have no manner of knowing how many such cases there are or to what extent wounds become infected in this manner. We shall have to let the matter pass by saying that it is quite certain that such infections must be reckoned with in any discussion of the treatment of compound fractures.

Now, in the third group we have also undoubtedly a considerable number of patients who have no great amount of infection at the beginning and who might have been treated by primary closure, and also we have a certain number who have received primary treatment without additional trauma or infection at the hands of competent surgeons, but who now come into the third class through becoming infected at the time of further operation or in the course of the daily or frequent surgical dressings. In order to refer to patients in these groups in the ensuing discussion I shall speak of them as primary infections at the time of injury, secondary infections at the time of first treatment or tertiary infections at the time of later surgical treatment or surgical dressings.

To any one who has observed a considerable number of patients with wound infections it is perfectly evident that the number of infections that occur in the tertiary group is very large and therefore, both the secondary and the tertiary infected cases contribute a considerable number to those compound fractures in which we have chronic osteomyelitis and poor results because of infection. In the method proposed by Dr. Carrel we have a fairly definite factor employed in order to assist us in deciding whether or not a wound is suitable for secondary closure, that is to say, the number of infectious organisms on the surface of the wound is determined as accurately as possible by laboratory study. One must say that the sense of security thus obtained both for the patient and for the surgeon is more apparent than real, as it has been found by frequent experience that in spite of such study pockets of infection and masses of infected tissue have been enclosed in such a sutured wound and have given rise to an amount of trouble that necessitates a reopening of the wound. This is particularly true in compound fractures for the drainage of which

certain very definite conditions must be maintained until sound healing has occurred.

For the reasons indicated the method proposed in the present paper is a standard method for dealing with these conditions and one in which variations in the amount of infection, the number and virulence of the organisms in the wound, the resistance of the patient, and the judgment of the surgeon, are any or all, factors that may be to a considerable extent disregarded, and the method becomes one which, whether you like it or not, may be referred to as a "fool proof" method.

There are certain fundamental factors that must enter into the treatment of compound fractures. These are adequate drainage during any period of infection, maintenance of all the parts in favorable position for circulation and repair, protection against muscle spasm and other forms of irritative motion, protection of the area against invasion of additional infection, and finally, sound healing in suitable position for resumption of function. If for any reason the surgeon or any one else concerned with the care of a compound fracture case, presumes to suspend or violate any or all of these fundamental rules, there is an interference with the course of treatment which may make it impossible to obtain a good result.

Before a surgeon invades a clean wound even to suture or place a drainage tube, or undertakes a primary closure, or does a dressing, or takes off a cast or splint, it is necessary to know upon exactly what factors he is to base his opinion that it is safe to violate the principles specified. If he has no such factors or if no good reason can be given, then a method of treatment should be found in which these fundamental rules can be observed. For example, a surgeon confronted by a recent compound fracture is asked to decide whether or not the wound is suitable for primary closure. Upon what is he going to base his opinion? It is quite obvious that he can base it upon nothing more than very general factors; his own experience in similar cases, a general estimate as to the amount of damage and infection in the wound, an opinion as to the patient's power of resistance, and a reliance upon the industry and intelligence of those to whom the after-care of the patient is to be entrusted.

These are all factors of the greatest variability and practically reduce such treatment to the question as to whether or not one can get away with it.

The same patient with a wide open wound, correct position in a plaster cast, protection against reinfection, and supervision by a competent surgeon will undoubtedly have a much better chance for the kind of result that it is hoped to obtain.

The method of treatment to be employed in such a situation is one upon which we received special light during the war, as shown by the results obtained after guillotin amputation. Here we had compound fractures with open wounds which could not be closed. There were neither sutures nor drainage tubes, drainage was certain to be adequate, and consequently we had a higher percentage of patients free from serious infectious complications than in other similar wounds.

If we can do the same sort of thing with our compound fractures—convert the wounds into wounds similar to those of the guillotin amputation, we can reduce the liability to gas gangrene and other infections which are due to covering up areas of infected tissue. In the same manner, complications due to sutures, tubes, and non-antiseptic invasions called dressings, in which the wound is traumatized and reinfected, may also be avoided.

The method of treatment that is proposed is not a theoretical conception only; for a number of years past we have treated our compound fractures in this manner.

Our custom is first of all to place the injured parts in correct position, employing fracture table, skeletal traction, etc., if necessary. Then primary treatment is given as simply as possible according to the condition of the wound. The wound is packed wide open in every part with an aseptic, non-absorbent mass and finally over a dry sterile dressing a splint or cast is applied which will maintain parts in correct position during the entire period of healing. In this manner primary infection is reduced or at least not added to. No stitches or tubes are employed. There are no irrigations or wet packs. The vaselin mass is inserted to facilitate drainage and for secondary protection. Finally, no dressings are done. The primary dressing is allowed to remain for a number of weeks (two to six) until wound healing is well established and until at least primary consolidation of the fracture has occurred. In a number of cases the result has been practically a primary closure and there is a procees that resembles a secondary closure in all. Local and general inflammatory complications, hemorrhages, etc., have occurred so rarely that they need not be considered.

All of the above remarks apply to recent contaminated (but not actively infected) bone and joint wounds.

We are all aware that certain of these, as recently pointed out again in an excellent article by Dr. Garlock of New York, may be successfully treated by primary suture. On this phase of the problem I have already expressed myself but I am quite prepared to say that some of my cases might have had their convalescence shortened if I had adopted one or the other of these procedures. Some of my cases, on the other hand (if my other observations and experience count for anything), would have had their convalescence lengthened by wound complications (immediate and remote) that they escaped by adequate drainage and rest.

For the actively infected case (after attempted primary suture has failed, for example), the treatment should be, not as usual—relaxation of splinting, daily dressings, etc., but by a cleaning out of the infected area, wide open drainage by a sterile pack, splinting in correct position and a careful avoidance of further irritative motion, and dressing infection. These are the patients that show even more strikingly than the primary ones the benefit of drainage and rest.

Following is an account of one of our most severe cases.

Mr. S., aged sixty-two, was badly crushed under a Ford tractor while working as a supervisor on one of our highways. There were compound comminuted fractures of both legs below the knee. He also had six or eight fractured ribs, a fractured clavicle, and numerous minor injuries. I saw him on the operating table where he was being prepared for amputation. In spite of extreme damage, I found the circulation in both legs and feet to be fairly good. The principal vessels were intact. Amputation seemed too severe an ordeal for him so I advised conservatism. He was quickly placed on the traction table, pins put through both heels, and both legs brought carefully down to full length and correct position. All wounds were then wiped out with iodin and alcohol, bones and soft parts adjusted to as good position as possible and all open wounds dressed with sterile vaselin gauze. (No stitches or tubes were used.) These were then covered with dry sterile gauze and a double leg cast put on. No windows were left in the cast and no dressings were done. The patient's after-care consisted only of alkalinization, fluids, and mild sedatives. (He had a few doses of opiates.) After about two weeks the amount of traction was increased, the wounds dressed and the casts repaired. For eight months thereafter this patient had dressings or casts (sometimes both) at intervals of three to four weeks only.

All wounds were healed before the fractures were sufficiently consolidated to bear weight, so that he began walking in caliper splints and with crutches. Now after fifteen months he walks quite well bare-footed without support or crutches.

As is customary in our cases, no stitches, drainage tubes, nor postoperative antiseptic dressings were used at any time.

DISCUSSION

Dr. F. J. Gaenslen, Milwaukee, Wis.: Dr. Orr's work on osteomyelitis, I believe, has progressed to the stage where he does not need anyone to tell of the advantages of his contribution in this important field. His work speaks for itself. I have used Dr. Orr's method for the past five years in the treatment of chronic osteomyelitis and in the latter part of this period also in cases of acute osteomyelitis with the greatest satisfaction.

The principle of rest in wound healing deserves all the emphasis given to it. Add to this the principle of adequate surgery, without which every method must fail, and the principle of adequate drainage, and you have the three essentials contributing to the success of the method. Adequate drainage implies wide incision, refraining from suturing even the angles of the wound and filling the wound completely with vaselin gauze which acts like a huge conical drain. The exudate which forms, finds its way to the surface between the walls of this conical drain and the wound surface without difficulty. With proper attention to the three principles above mentioned, you will have no reason to fear any ill effects from the use of what may seem to be a very radical procedure. As I say, I have been a firm advocate of this method, and I have the conviction that Dr. Orr's work will stand for many years. There is no question in my mind about that.

I think a factor in wound healing which we are likely to forget and one to which our attention has rarely been called is the factor of pressure. The vaselin exerts a pressure which I believe is comparable to the normal degree of pressure in the physiology of the cell. All the tissues in the body are under a certain amount of normal tension. If you inflict a wound, the layer of cells on the surface of the wound is deprived of that normal tension which is necessary for its normal physiology, and the cells are apt to become water-logged as seen so frequently in chronic ulcer of the leg. Variations in pressure on the surface of the wound are accompanied by definite changes in appearance. That pressure is an important factor may be readily demonstrated in a case of chronic leg ulcer by varying the position of the part. After a few minutes in the standing position, the granulation tissue becomes bluish-red and engorged. The cells become water-logged. The wound weeps. If we could see these cells enlarged a thousand times and study their physiology, we would probably find enormously distended cells seriously hampered in the attempt to carry on their normal activity. We would expect retarded growth, defective repair, and certainly diminished resistance to infection. If, on the

other hand, the leg be raised to above the level of the bed and maintained in this position for a few minutes, the color of the granulating surface improves promptly, the engorgement gradually recedes, the wound no longer weeps. All this is evidence that important physical factors are at play, a most important factor probably being deviation from an optimum of pressure on the cells constituting the granulation tissue. I believe therefore, that the vaselin is important, not only because of its action as a drain, but also because it supplies that degree of pressure which is conducive to rapid wound healing. If instead of the vaselin mass, a firmer mass like paraffin were substituted, the pressure on the growing cells would be too great, and necrosis would result. If, on the other hand, the mass were less solid, the pressure would be insufficient and disturbance of normal cell physiology would result in excessive secretion and interference with processes of repair and defense against infection. So far as pressure is concerned, the vaselin would seem to be practically foolproof, granting, of course, that the other principles involved are duly considered.

I will cite one case which may impress those of you who have not used the method with the advantages of it.

A young man, about twenty-five years of age, fell thirty feet out of a tree on December 7, with the temperature below zero, patient sustaining a fracture of the middle one-third of the femur. He dragged himself one-quarter of a mile to his home where he received first aid and was taken to a hospital where traction was applied. At the end of six weeks the cast was removed and he had no further fixation. On examination later there was an over-riding of the fragment and angulation. He was taken to the hospital and an open operation performed. A six-screw Lane plate was applied. He was discharged with a plaster cast extending from just above the knee to just below the hip. Soon afterward it was discovered that the plate had broken, and angulation occurred with suppuration. He was in that condition when I first saw him at the hospital. I opened the wound widely, removed the broken plate and with a rongeur took off the small pieces of bone, put on ice tongs, put in a vaselin dressing and applied a plaster cast. It is now four and one-half months and that man has been dressed but twice, the last time through an opening in the cast. The wound is practically closed and I anticipate no difficulty.

Contrast that treatment with any chemical treatment you may think of, Carrel-Dakin or any other. If you get a satisfactory result in that way with no danger, no pain, no cellulitis, I feel that it has real merit. My experience with the acute cases has been quite as satisfactory as with the chronic. In using the bone pins, I would prefer to use a smaller pin than Dr. Orr does. I use knitting needles which are easily cut off and which can be removed without difficulty.

Dr. M. S. Henderson, Rochester, Minn.: I am not going to cite any cases. I have used Dr. Orr's method a great deal with very satisfactory results. It is not a foolproof method. There must be good surgery back of it. I have heard many criticisms against it; for instance, that it was unsound in surgical principles. I think the very opposite is true, as Dr. Gaenslen has pointed out. Every possible amount of drainage is provided. The large vaselin pack helps. The unusual departure from any standard method is that the dressings are not changed. The discharge lies there in the dressings and does make a bad odor. I think the reason the method has not gotten the credit it should be given is that it is not carried out as Dr. Orr stated. The wound must be left open. When I started to use it I packed it fairly well, then closed it around the edges. That is not the way to do it. As Dr. Orr showed, the wound should be left open wide and the cavity filled with a pack. The method consists in good surgery, cleaning out the sequestra and putting in a big vaselin pack. Dr. Orr puts on the cast and allows the odors to wander as they choose and often they are not very pleasant. I give my patients a little bottle of oil of wintergreen, and tell them to sprinkle it along the edge of the cast, and see if they cannot put up with the odor for two or three weeks.

Dr. Frank Ober, Boston, Mass.: For several years I have been taking care of the osteomyelitis cases in the Boston Children's Hospital and the thing that struck me in the

early days was that these wounds healed over more rapidly on the outside than the bone healed on the inside and then we got the sinuses that lasted for years. Then I began putting in a cigarette drain and found we got better results if they were not disturbed for forty-eight hours. In 1921 I read a paper before this Society on the treatment of septic knees following gunshot wounds. I said there were three things we should do to handle sepsis in bone. I showed that the cases that were dressed every day had a rise of temperature at night. I learned to omit the frequent dressing. Then I discovered if the knees were passively moved just a little the man would run a temperature at night. I also discovered that if the wounds were washed out frequently the man had a temperature at night. Then it was decided not to dress these wounds oftener than every three days. The infrequent dressings, no postoperative irrigations, and keeping the wounds open gave us better results and there were no deaths from septic knees.

I think the point Dr. Orr makes of infrequent dressings diminishes the sepsis and allows the wound to heal from the bottom and the patient gets well because the wound heals from the bottom and the bone has a better chance to take care of itself than it does if it heals from the outside first.

Dr. H. Winnett Orr, Lincoln, Nebraska (Closing the discussion): Gentlemen: I always feel very grateful to Dr. Gaenslen, not only for his excellent discussions but for the fact that he was one of the first and most successful in the use of this method. It is sometimes said that no one succeeds with a new surgical technique except the author of the method. Certainly this is not true of this method. Dr. Gaenslen has been extremely successful in a large number of cases and has followed closely the original method proposed about five years ago.

His suggestion with regard to pressure is an interesting one—I have referred previously to the practice of Gamgee, an English surgeon contemporary with Lister. Gamgee was an advocate of compression by itself as a method of wound treatment. He advocated "the kind of pressure that one applies to the hand of a lady whom one greets after an absence, with feelings of respect and regard".

One of the things we have found out about this method in severe wounds of the soft parts and even in large cavities after operations for chronic osteomyelitis is that bone areas cover over quickly and completely. Frequent dressings, however done, certainly interfere with epithelialization. Nowhere except in the hand (palmar surface) and fingers have we resorted to fat or skin grafts. No cavities in tibiae, femora, humeri, etc. have failed to fill up and heal over quite promptly under the vaselin pack.

With regard to the use of skeletal traction, it is our opinion that with true "fixed traction" either in Thomas splint or in plaster cast, pins and ice tongs may be used without fear of complications. We have had no major complications in any of our cases. Such minor complications as we have had have been due to interference in some manner with the complete immobility of the traction devices. So far as we can see the larger soft steel pins do no harm and never break.

Dr. Henderson has mentioned an important point with regard to the use of the method exactly as described. Upon the suggestions of others and on my own account I have tried many variations in technique. I have left off casts, tried various splints, medicated dressings, etc. with practically always a loss in efficiency.

If there is any departure from the *principles* laid down at the beginning there are poorer results at once.

What Dr. Henderson says about discharge is also important. It bears upon the points also raised by Dr. Ober. Surgical dressings irritate the wound as well as the patient. Particularly if chemicals are being applied to the wound surface there is an increase of discharge as well as pain and rise of temperature on each occasion.

It has been our experience in using our method, that at the end of three to six weeks there is usually no more discharge in and about the wound than is to be found each time upon daily dressing. Moreover, even in the presence of such a discharge and during such a period there is found to have been satisfactory progress in healing during the whole time.

IN MEMORIAM

The following memorials were presented at the Annual Meeting of the American Orthopaedic Association in Washington, May 1, 1928.

VIRGIL P. GIBNEY

BE IT RESOLVED, that whereas by the death of Dr. Virgil P. Gibney the American Orthopaedic Association has lost one of its founders and most constant leaders, the profound regret of the members be and hereby is expressed, and be it resolved that this expression be spread upon the records of the Association.

At the birth of the Association Dr. Gibney was its chairman. His skill, good judgment, and geniality won the respect of the entire medical profession. He exerted commanding influence in shaping the policy of a great hospital. For forty years he occupied a unique place in the ranks of the Association and in the hearts of its members.

JOSEPH M. SPELLISSY

Dr. Joseph M. Spellissy died on August 27, 1927. He had been a member of the American Orthopaedic Association since 1902. He received the A.B. degree from Georgetown University, Washington, D. C., in 1895, A.M. from the same college in 1890, and M.D. from the University of Pennsylvania in 1890. He was actively engaged in surgery and orthopaedic surgery, in connection with several of the Philadelphia hospitals and founded the Department of Photo-anthropometry in the Orthopaedic Department of the University of Pennsylvania. He contributed numerous articles on medical subjects which reflected the thoughtful and careful traits of mind which were so characteristic of him. He was beloved by his patients and devoted himself and his time to them most unsparingly.

GEORGE B. PACKARD

Dr. George B. Packard died at his residence in Denver, Colorado, on February 23, 1928, after a brief illness. He was born in Jericho, Vermont, in 1852 and came to Colorado in 1889. One year later, in 1890, he settled in Denver and began the active practice of orthopaedic surgery, being the pioneer in this field of surgery. Through his faithful and untiring efforts, a Department of Bone and Joint Surgery was established at the old Denver and Grosse Medical College, which afterwards merged with the University of Colorado, and he held the first professorship in this specialty. This position he filled until 1919, when he became Emeritus Professor of Orthopaedic Surgery. Dr. Packard was one of the creators and founders

of the Children's Hospital Association in Denver. It was the first hospital in Colorado to be built and maintained for the treatment of the sick and crippled child. As a founder and first president of the Medical and Surgical Staff, he served, and served well, for seven years.

Dr. Packard was one of the charter members of the American Orthopaedic Association, and at the First Annual Meeting he presented his first scientific case report, which was afterwards published in the first volume of the transactions, entitled "Hypertrophy of One Lower Extremity". In 1914, he was elected President of the Association.

He was a member of the American College of Surgeons, and of the Clinical and Pathological Society of Denver; he also held memberships in the American Medical Association and the Denver City and County Medical Society, holding the presidency in the latter society from 1914 to 1915. Up to the time of his death, he was one of the attending orthopaedic surgeons at the Children's Hospital, St. Joseph's Hospital, and the Mercy Hospital, and consultant to St. Luke's and the Denver General Hospitals. He was a contributor of many valuable surgical monographs.

But it is not because of Dr. Packard's surgical ability and professional standing alone that we mourn him, but the great loss to the profession and to the laymen; his friends and colleagues have lost a wise counsellor and devoted friend. His charming and courteous manner will always be remembered by those of us who have known him intimately for many years. His loss is irreparable, but he leaves behind him an everlasting monument. A surgeon of the highest ability and ideals, he was always modest, tactful, and considerate in scrupulous measure of the feelings of others. A useful and beautiful life has passed beyond,—one which it was a privilege to have known.

NEWTON MELMAN SHAFFER

Dr. Newton Melman Shaffer, who died January 2 in St. Luke's Hospital, New York City, was born at Kinderhook, N. Y., February 14, 1846, the son of the Rev. James Newton and Jane Emeline Shaffer. In 1873 he married Margaret H. Perkins of Gardiner, Maine, who died in 1909.

Dr. Shaffer was connected with the Hospital for the Ruptured and Crippled from 1863 to 1868. From 1870 to 1898 he was Assistant Surgeon and Surgeon-in-Chief at the New York Orthopaedic Dispensary and Hospital. He then set to work to develop a plan he had had in mind for some time to establish a State Hospital for the care and treatment of crippled and deformed children, and prepared a bill establishing a hospital for this purpose and secured its passage by the State Legislature in the year 1900. He served as Surgeon-in-Chief for the New York State Orthopaedic Hospital for Children until he resigned in 1910, continuing his connections on the Consulting Staff.

Dr. Shaffer was one of the founders of the American Orthopaedic Association, was elected as its President in 1888 and faithfully attended its meetings, in which he took an active part. He was one of the charter

members of the American College of Surgeons, member of the American Medical Association, and of the Academy of Medicine.

He held many positions of importance, among which were the following: from 1872 to 1887, Attending Orthopaedic Surgeon at St. Luke's Hospital, subsequently and until his death, Consulting Surgeon; Consulting Orthopaedic Surgeon to the Presbyterian Hospital; Professor of Orthopaedic Surgery at the New York University Medical College and later at the Cornell Medical College. At the time of his death he was Emeritus Professor at Cornell; chairman of the committee which secured the admission of the American Orthopaedic Association to the Congress of American Physicians and Surgeons in 1888; chairman of the committee which secured recognition of Orthopaedic Surgery as a specialty at the Tenth International Medical Congress in 1900; first Chairman of the Orthopaedic Section of the American Medical Association in 1913.

His greatest genius lay in his mechanical skill in devising and applying braces to meet the demands expressed by Nature for the correction or cure of pathological conditions. Of the many ingenious braces which he originated, his peg-stop knee brace deserves the greatest notice. He always advocated encouraging normal physiological functions, and therefore sought to make his braces as much a part of the patient as possible and as little confining as compatible with their object. His penetration into the meaning of signs and symptoms led him to describe conditions and advocate treatment years before the profession as a whole was able to accept his teaching. Notably may be cited the condition at the ankle which he termed "non-deforming club-foot" and which he described in an article in 1885. His description of tuberculous disease of the hip written in 1877, and his lectures on Ankle Joint Disease, published in 1882, are as modern today, except for the advance which has been made in pathological knowledge. He advocated and practiced traction and abduction in the treatment of ununited fractures of the hip as long ago as 1886, and his description of the mechanics in approximating the fractured ends and retaining the apposition is a classic in surgical literature.

Dr. Shaffer had to a marked extent the conviction of his views. His readiness to combat opposition at times cost him the friendship of those who were not able to agree with him but he did not lose the respect of his antagonist, who could not fail to recognize his preeminence in his specialty. His extensive experience in a large clinical work, his powers of keen observation and his ability as a teacher place him in the foremost rank of Orthopaedic Surgery, commanding a respect and honor from the medical profession which will keep his memory alive for years to come.

News Notes

The Forty-second Annual Meeting of the American Orthopaedic Association was held in Washington May 1, 2 and 3, 1928. There were seventy-four members and sixty-one guests registered.

On the day preceding the Meeting, April 30, an interesting Clinical Day, arranged by Dr. Aurelius R. Shands of Washington, was presented at the Walter Reed and other hospitals.

Great credit is due the Program Committee for the unusually fine program arranged for the Meeting. It was presented as follows:

TUESDAY, MAY 1, 9.30 A.M.

Address of the President.
Dr. A. MacKenzie Forbes, Montreal, Canada.

Further Study of Crush Fractures of the Spine.
Dr. James O. Wallace, Pittsburgh, Pa.
Discussion by Dr. James W. Sever, Boston, Mass.

A Demonstration of the Abduction Method and the Reconstruction Operation as Exponents of a Comprehensive and Standardized Treatment of Fracture of the Neck of the Femur.
Dr. Royal Whitman, New York, N. Y.
Discussion by Dr. A. R. Shands, Washington, D. C.

Ossifying Hematoma.
Dr. Sydney M. Cone, Baltimore, Md.
Discussion by Dr. E. L. Eliason, Philadelphia, Pa. (By invitation).

Non-union of Tibia in Children.
Dr. Melvin S. Henderson, Rochester, Minn.
Discussion by Dr. Fred Albee, New York, N. Y.

A Further Report on the Transplantation of the Tensor Fascia Femoris Muscle for the Purpose of Stabilizing the Hip Joint in Infantile Paralysis.
Dr. Frank D. Dickson, Kansas City, Mo.
Discussion by Dr. DeForest P. Willard, Philadelphia, Pa.

12 M. Executive Session.

TUESDAY, MAY 1, 2.00 P.M.

Peripheral Nerve Complications of Certain Fractures.
Mr. Harry Platt, M.S., F.R.C.S., Manchester, England (By invitation).
Discussion by Dr. Dean Lewis, Baltimore, Md. (By invitation).

Why Do Some Giant-cell Tumors Recur After Curetting and Why is Ossification Sometimes Incomplete in the Benign Bone Cyst?
Dr. Joseph Colt Bloodgood, Baltimore, Md. (By invitation).

The Early Diagnosis of Sarcoma of the Long Bones, Based Upon the Clinical, Pathological, and X-ray Findings.
Dr. William B. Coley, New York, N. Y. (By invitation).
Papers by Drs. Bloodgood and Coley discussed by Dr. D. B. Phemister, Chicago, Ill., and Dr. James Ewing, New York, N. Y. (By invitation).

Supracondylar Fractures of the Elbow Joint. Some Problems and Complications.
Dr. Charles F. Eikenbary, Seattle, Wash. (Read by Title).

Problems in the Diagnosis and Treatment of Osteo-arthritis of the Hip Joint.
Dr. Elliott G. Brackett, Boston, Mass.
Discussion by Mr. George Perkins, F. R. C. S., London, England (By invitation).

Posterior Capsuloplasty in Certain Flexion Contractures of the Knee.
Dr. Philip D. Wilson, Boston, Mass.
Discussion by Dr. David Silver, Pittsburgh, Pa.
End Results of Arthroplasty of the Knee.
Dr. Willis C. Campbell, Memphis, Tenn.
Discussion by Dr. William S. Baer, Baltimore, Md.

WEDNESDAY, MAY 2, 9.00 A.M.

An Operation for the Reduction of Certain Types of Congenital Dislocation of the Hip.
Dr. Paul P. Swett, Hartford, Conn.
The Development Changes in the Hip in Congenital Dislocation,—Their Importance in Treatment.
Dr. Nathaniel Allison, Boston, Mass.
Reconstruction of the Hip in Irreducible Dislocations, Congenital and Pathological.
Dr. A. Bruce Gill, Philadelphia, Pa.
Congenital Dislocation of the Hip. Report of an Unusual Case.
Dr. John Ridlon, Chicago, Ill.
Papers by Drs. Swett, Allison, and Gill discussed by Mr. Harry Platt, Manchester, England, Dr. Robert Soutter, Boston, Mass., and Dr. B. P. Farrell, New York, N. Y.
Prognostic Signs in the X-rays of Tuberculous Spines in Children.
Dr. Ralph K. Ghormley, Boston, Mass.
Discussion by Dr. John L. Porter, Chicago, Ill.
Some Orthopaedic Problems of the Lower Jaw.
Dr. Robert Ivy, Philadelphia, Pa. (By invitation).
Discussion by Dr. V. P. Blair, St. Louis, Mo. (By invitation).
Polyarthritis with Special Reference to Bacteriology.
Dr. Alexander Gibson, Winnipeg, Canada.
Discussion by Dr. Robert B. Osgood, Boston, Mass.
1.15 P.M. Executive Session.

THURSDAY, MAY 3, 9.00 A.M.

The Treatment of Wound Infection, Especially of Bones and Joints, without Sutures, Drainage Tubes, or Antiseptic Dressings. Lantern Slides.
Dr. H. Winnett Orr, Lincoln, Nebr.
Discussion by Dr. Alexis Carrel, New York, N. Y. (By invitation).
Tuberculosis of the Spine. A Report of the End Results in All Cases Treated by Fusion at the New York Orthopaedic Hospital, January, 1915-1920.
Dr. Russell A. Hibbs, New York, N. Y.
Discussion by Dr. Edwin W. Ryerson, Chicago, Ill.
Results of Spine Fusion for Scoliosis.
Dr. Samuel Kleinberg, New York, N. Y.
Discussion by Dr. Frank Ober, Boston, Mass.
Bactericidal Action of Various Metals Upon Certain Organisms in Relation to Metallic Internal Fixation of Tissues.
Dr. J. Torrance Rugh, Philadelphia, Pa.
Report of a Case of Sclerosing Osteomyelitis Associated with Trichinosis.
Dr. George E. Bennett, Baltimore, Md.
Diagnosis and Treatment of Acute Arthritis of the Hip.
Dr. Philip W. Nathan, New York, N. Y. (Read by Title).
12 M. Executive Session.

Memorials on the deaths of members of the Association during the year were presented as follows: Dr. Virgil P. Gibney, presented by Dr. Robert B. Osgood; Dr.

Newton M. Shaffer, by Dr. John J. Nutt; Dr. Joseph Spellissy, by Dr. J. Torrance Rugh; Dr. George B. Packard, by Dr. S. Fosdick Jones. All of these were adopted by the Association and appear in full on another page of this issue of the *Journal*.

Six new members of the Association were elected, as follows:

John D. Adams, M.D., Boston, Mass.
Hugh T. Jones, M.D., Rochester, Minn.
H. P. Mauck, M.D., Richmond, Va.
W. R. MacAusland, M.D., Boston, Mass.
Kellogg Speed, M.D., Chicago, Ill.
C. C. Yount, M.D., Pittsburgh, Pa.

Also, as corresponding member,

Dr. Way-Sung New, Shanghai, China.

The following officers were elected for the year 1928-1929:

President-Elect: Zabdiel B. Adams, M.D., Boston, Mass.
Vice-President: J. Torrance Rugh, M.D., Philadelphia, Pa.
Secretary: DeForest P. Willard, M.D., Philadelphia, Pa.
Treasurer: John L. Porter, M.D., Chicago, Ill.
Executive Committee: A. MacKenzie Forbes, M.D., Montreal, Canada.
Program Committee: Samuel Kleinberg, M.D., New York, N. Y.
Membership Committee: Frank R. Ober, M.D., Boston, Mass.

Delegates to the American College of Surgeons: A. H. Freiberg, M.D., Arthur Steindler, M.D., and Edwin W. Ryerson, M.D.

The Association voted to send to Sir Robert Jones, of Liverpool, a message of felicitation on the occasion of his seventieth birthday, which occurred on June 28.

Dr. W. G. Turner has moved his office to 386 Sherbrooke Street West, Montreal, Canada.

The office of Dr. Alfred E. Gallant has been moved to Suite 1033, Roosevelt Building, 727 West Seventh Street, Los Angeles, Calif.

Dr. Charles F. Eikenbary and Dr. John F. LeCocq have announced their association in the practice of orthopaedic and fracture surgery. Their office is located at 518 Stimson Building, Seattle, Washington.

A son was born to Dr. and Mrs. Way-Sung New of Shanghai, China, on March 25. The *Journal* extends congratulations to its Foreign Editor for China, and to Mrs. New.

An unusual feature of the Annual Meeting of the **Hospital for Joint Diseases**, held on April 15, was the unveiling of the statue erected to the memory of the founder of the hospital, Dr. Henry W. Frauenthal. An address was delivered by Dr. Joseph C. Bloodgood, of Baltimore, Md.

The Second International Conference on Light and Heat in Medicine, Surgery, and Public Health will be held in London, October 29 to November 1, 1928. The First International Conference was held in London last December, and proved to be of great importance. An even larger number of medical and scientific authorities will take part in this Second Conference, which will be held in the University of London, South Kensington. An exhibition of the most up-to-date apparatus and accessories for ultra-violet, radiant heat, and similar forms of therapy will be held in connection with the Conference. Requests for details about the Conference and Exhibition should be sent to the British Journal of Actinotherapy, 17 Featherstone Buildings, High Holborn, W.C.1., London.

Orthopaedic Surgery in Holland

The Foreign Editor of Holland, Dr. Murk Jansen, in response to the request of the Editorial Bureau, has given a brief statement relative to the position of orthopaedic surgery in Holland. So little is known of the development of orthopaedic and industrial surgery in different countries, and during recent years interest in these two branches of surgery has so increased, that it is of value to offer this information to the readers of the *Journal*.

Communications on the same subject, from the Editors of other countries, will be published in forthcoming issues of the *Journal*.

Editor.

Two of the four universities in Holland have lecturers on orthopaedic surgery: namely, Amsterdam and Leiden. They are not salaried. None of the universities has an orthopaedic department. Only Leiden University has an Orthopaedic Outpatient Department, which was started in 1904. Since 1914 three beds have been reserved for operative cases during term-time, *i.e.*, twenty-five to twenty-six weeks each year, and the use of the operating theatre one morning each of these weeks. Nearly 10,000 patients have been dealt with during these years, and a few hundreds of operations done. The clinic is led by an orthopaedic surgeon, and during the last eight or ten years both the conservative and the operative treatment have been largely performed by his assistants, who are paid from private resources. Some improvement may be expected within a few years, when the new surgical building of the Leiden University Hospital will be ready for use, to which a properly equipped orthopaedic department with ten beds is being added. Meanwhile, through the training in the University Hospital, combined with experience with the private patients of the lecturer, four of these assistants have obtained sufficient training to successfully carry on private orthopaedic practice in different cities of Holland.

In 1898 a few medical men who practiced orthopaedic surgery, largely along conservative lines, founded the Netherlands Orthopaedic Association. The membership of this Association has grown to about thirty, among whom there is an increasing number who have had the indispensable surgical training. They meet three times a year. The papers and discussions are published in the "Nederlandsch Tijdschrift voor Geneeskunde". This journal, being read by about 4,000 medical men, has doubtlessly done much to bring home to the profession, both in Holland and in her colonies, the rapid development and importance of this new branch of medical science.

There are four charitable institutions for the deformed in Holland: The Johanna Home in Arnhem, the Adriaan Home near Rotterdam, the Cornelia Home in Beetsterzwaag, a small village in the north of Holland, and the Orthopaedic Department of the Wilhelmina Hospital in Amsterdam. The Johanna Home, with thirty-seven beds, erected in 1891, is almost purely educational; and the Adriaan Home, with forty beds, was also intended as a home of the conservative type, but since it was opened in 1914 an operating theatre has been added. The Cornelia Home, an old manor home, was bequeathed by the late Baron and Baroness van Lynden for the benefit of ailing and crippled children in the province of Friesland, and was opened in 1915. It owns about $400,000. It has a neat operating theatre, and two open-air sheds have been added lately, providing room for about thirty crippled children. The Orthopaedic Department of the Wilhelmina Hospital in Amsterdam was opened in 1921 as the necessary addition to the Municipal Orthopaedic Dispensary for the poor which had existed for many years. It contains sixteen beds, and a workshop for the making of appliances is connected with it.

To the 120 special beds for orthopaedic cases, fifty-seven will soon be added in Leiden. The "Society for the Deformed" in this city, which was founded in 1919, has been able to buy a beautiful site on the outskirts of the town on which an orthopaedic hospital is being built, the building sum for which was given by the Society's president. The hos-

pital is to be opened by June 1929. The urgency of operative help for the cripples in Holland being paramount, the Society board have decided that the hospital shall be largely of a reparative character. As soon as more funds shall be collected, workshops and schools will be erected on the site, in which vocational training and tuition will be provided.

Since December, 1925, the Rotary Club of Holland has been aiding the plans of the Leiden Society for the Deformed by convoking promotional meetings, which have yielded about $2,000. The Rotary Club of America having directed the attention of the Rotarians in Holland to an article in the "Cripples' Journal" dealing with the problem of the cripple in Holland, a report was made on this subject and distributed among the Rotarians in Holland, the orthopaedic surgeons, and the professors of surgery. They were all convoked to a meeting on December 18, 1926. An interesting feature of the meeting was that the professors of surgery were unanimous in declaring that no special help for cripples was needed.

This led the Rotary clubs of Holland to conclude that the position of the University professors of surgery kept them away from the vast deficiency which there is in Holland with regard to the care of cripples as compared with other countries, and to decide that they shall abet the cause of the cripples in Holland as best they can. Thus the judgment of an impartial body of well-meaning men may prove helpful in moulding public opinion. This may be the more readily expected since a Central Committee for the Care of Cripples in Holland has been formed, in which the various bodies for the care of cripples are represented. And the time seems not far that powerful persons or institutions shall realize that eradication of crippledom and anything making an approach towards it, means an increase of happiness and welfare to the community. Till then we will "keep on keeping on", as one of your noble countrymen is wont to say. And should we ever doubt of success, we will think of the maxim of our Prince William the First of Orange: "*N'est besoin d'espérer pour entreprendre, ni de vaincre pour persévérer*". For the present, however, we are fortunate enough to carry on with good hope and courage.

Murk Jansen, M.D., Leiden, Holland.

In 1869 the editors of medical journals in the United States united and organized the **American Medical Editors' Association.** The idea originated with Dr. Theophilus Parvin, Editor of the "Western Journal of Medicine", and at the first meeting, in May 1869, Dr. N. S. Davis was elected president. The Association became an active organization, and exerted a definite influence during its many years of activity.

After the death of the last president, Dr. Henry O. Marcy, the organization became inactive and has remained so for five years. Dr. H. Lyons Hunt, now President, in January 1928 called a meeting of the editors in New York to discuss the advisability of reviving the activity of this Association. The vote was unanimous in favor of so doing and practically all the old members rejoined the Association, and over one hundred new members have been added.

This Association now has the opportunity, under the active leadership of Dr. Hunt, to resume its active beneficial influence.

At the District Conference of Rotary International, held in Columbus, Miss., April 18 and 19, the Mississippi Society for Crippled Children was formed.

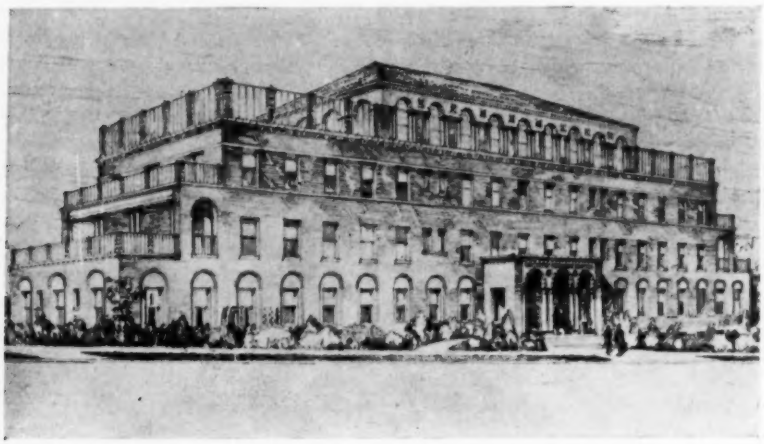
The West Tennessee Society for Cripples was organized in Memphis on March 15. This organization is planning a cooperative state-wide program with the Tennessee Society for Crippled Children.

The 1928 Directory of the **International Society for Crippled Children** and Affiliated Societies has recently been issued and may be obtained from the office of the International Society for Crippled Children, Elyria, Ohio. This Society issues an occasional bulletin which tells of the activities of both national and local societies.

The International Conference of Social Work will be held in Paris in July. The

National Conference of Social Work is serving as the representative in the United States and has arranged for a delegation of about one hundred official representatives from the United States.

The International Society for Crippled Children has been invited to join in a program for the education of physically handicapped persons, to be held in connection with the World Federation of Educational Associations in Geneva, sometime during the year 1929.



Children's Orthopaedic Hospital, Seattle

On January 15, 1928, the new wing of the **Children's Orthopaedic Hospital,** located in Seattle, was formally opened for the admission of patients. The capacity of this hospital will be 150 beds. The hospital is as complete as it is possible for a modern hospital to be. Among other features is a very large swimming pool in the physiotherapy department, for the use of paralytic cases. The entire upper floor of the hospital is used for schoolroom purposes, manual training, and has a playground for the children.

From Dr. Philip Lewin, of Chicago, comes the following suggestion as to a simple method by which lantern slides made from typewritten sheets may be clearly legible: Instead of making an ordinary carbon, the carbon sheet is turned around so that the carbon portion of it is on the back of the original sheet. Then the typewriting is done. It will be found that a lantern slide made from such a sheet will be plainer than one made in the usual way.

At the **Children's Hospital, Boston,** on Wednesday afternoon, May 16, Dr. Charles L. Lowman of Los Angeles gave an interesting talk about his under-water-exercise treatment for cases recovering from poliomyelitis, and asked that such treatment be not confused with swimming exercises. The weakened muscle groups only are considered when planning exercises, and positions on the back, abdomen and sides are assumed in the water, in order to bring into play the desired muscle groups. Dr. Lowman says that these exercises under water are just as carefully given and supervised as they would be in the treatment room. They do not take the place of regular systematic muscle training, but rather supplement it with an added modality. Acute cases are taken into the water as early as the end of the fifth week or the early part of the sixth, even if tenderness persists, provided there is no kidney complication.

The tank used by Dr. Lowman in Los Angeles has a supply of salt sea water, into which a stream of hot water is added, bringing the temperature up to around ninety

degrees, the depth of the water being about two feet, six inches. Cement blocks are arranged at the sides of the tank to take the place of the regular gymnasium tables, from which the exercises are given, and the assistants stand in the tank. Dr. Lowman's ingenuity in the way of inventing names for apparatus and games attracts the child's attention: for example, inflated balls joined together make a "bubble boat", from which floating is made easy so that exercises from the supine or prone-lying positions under water may be given.

A meeting of the **Boston Orthopaedic Club** was held on Monday, April 16, 1928, at the Beverly Hospital. Dr. Peer P. Johnson and Dr. John D. Adams presented a series of fractures, showing end results. They were most excellently presented, and showed the greatest care in their treatment. General discussion followed. After dinner had been served to the members of the Club, Dr. Adams presented two cases of fractured carpal scaphoid, one treated by complete excision, and the other treated by bone graft. In the first one the result was very satisfactory, although the patient had a little pain at times. The second one was apparently a complete cure. As this patient was a boxer by profession the result seemed excellent.

Mr. Harry Platt of Manchester, England, then spoke on the subject of "Ruptured Tendons", especially ruptures of the tendo Achillis and extensor pollicis longus. His experience has been quite extensive in these cases. He told of the difficulty in treating them and described the method of treatment with fascia suture, and his end results. This was discussed by Dr. Cotton, Dr. Wilson, Dr. Osgood, and Mr. Perkins of London.

A meeting of the Boston Orthopaedic Club was held on May 21, 1928, at the Lakeville Sanatorium, Lakeville, Mass. The Club members were invited as the guests of Dr. Z. B. Adams and Dr. Leon A. Alley. Informal rounds of the wards were made and the patients and their x-rays were inspected. Every one felt very much impressed with the splendid work that is being done at the institution. Dinner was served in the dining hall, and short speeches were made by Dr. Bigelow, State Commissioner of Health, Dr. Sever, Dr. Adams and Dr. Ridlon.

A determined effort is being made in the **State of Michigan** to handle the problem of the crippled child. Until the last four or five years there has been no organized effort to care for the hidden or destitute handicapped child, except a law which provides that all such children may be sent to the University of Michigan Hospital for treatment.

About five years ago groups of Rotarians, following the example of such organizations in other states, undertook to run free clinics in different districts of the state. The Rotarians hunted up the cripples in a given neighborhood, and on a certain day collected tnem at a central point. One of the established orthopaedic men of the state was invited to go to this central point, and examine all the cases submitted to him, and prescribe a course of future treatment. These clinics brought out of hiding an extraordinary number of neglected crippled children, and they did an immense amount of good by stimulating interest, both in the parents and in the people of the community. They were disappointing in that lack of space in organized hospitals, lack of organization, and lack of interest among the parents prevented, in many cases, the execution of instructions given by the visiting orthopaedic surgeon.

This work of the Rotarians was so useful that it aroused tremendous public interest, with the result that the Michigan Branch of the International Society for Crippled Children was greatly strengthened in numbers and influence, and acquired some political power. This led, in 1927, to the passage of a new law by the State Legislature, which established a Commission to be appointed by the Governor of the State, to study the crippled child situation in a thorough way. Funds were provided for the continuation of the state-wide clinics under the supervision of the Commission. A tentative plan was also provided in the law for a census of the cripples in the state. The law also provided that cases might be sent to other orthopaedic centers as well as to the University of Michigan.

At present the Commission is functioning actively and wisely, and has called upon the ten full-time orthopaedic surgeons of the state to assist and advise it, as well as to care for the clinics. This cooperation is being gladly given, and clinics will be continued on a larger scale than ever before. The fact that the State is behind the effort will undoubtedly lead to a much larger percentage of continuous and intelligent treatment.

It is hoped that through this beginning, sufficient knowledge of the situation and interest in the crippled child will be aroused, to force the passage of a new law adequate to care for all of the poor cripples of the state thoroughly. To do this, more money must be provided. There must be an enabling clause which will make it possible for local authorities to insist upon compulsory treatment. It is hoped that provision may be made for the establishment of new centers where competent young orthopaedic surgeons may settle, and with the encouragement of the State's aid, care for the poor children and incidentally establish a local practice.

At present there are only three centers equipped for efficient orthopaedic care. These are in Grand Rapids, at the University of Michigan, and in Detroit.

CLINICAL CONFERENCES AT THE HOSPITAL FOR RUPTURED AND CRIPPLED, NEW YORK CITY

CONFERENCE OF JANUARY 26, 1928

The President, Lewis Clark Wagner, in the chair.

Dr. Percy W. Roberts — An Unusual Case of Tuberculosis of the Thigh.

Dr. Roberts presented the case of a child, aged twelve, who for two years has had an enlargement of the left thigh unaccompanied by discomfort until a few weeks before admission to the hospital. Clinical examination revealed enlargement of the thigh without the presence of a circumscribed mass in the thigh. X-ray was negative as to bone lesion. An exploratory operation was done. When the thigh was opened, a large mass of semi-organized material was encountered in the soft parts without free pus. This was removed with a curette. Continuing exploration up the femur, a fibrous mass was discovered about one inch below the greater trochanter. A portion of this was removed for microscopic examination and the wound was left open for drainage. The laboratory reported tuberculosis in both the soft tissue removed from the thigh and the fibrous tissue removed from the femur. Wound healed by granulation and the child made an uneventful recovery.

Dr. Carl G. Burdick—Acute Osteomyelitis, Three Cases—with Early Operation.

Dr. Burdick presented three cases of acute osteomyelitis in children with early operation. Boy, seven years of age, fell while skating six days before. On admission, there was swelling and a local point of tenderness over the lower part of the tibia. Temperature 102.8 degrees, blood count—leucocytes 18,800, eighty-five per cent. polynuclears. Operation: Two-inch incision over lower end of tibia at site of local tenderness, which was on the antero-external surface. Periosteum raised, yellowish in color and on incision about two drams of pus escaped. Surface of bone roughened and on drilling into the medulla, several drops of pus were found. Culture showed staphylococcus aureus. Two or three additional drill holes were made just above the epiphysis and the wound was subsequently treated by the Carrel-Dakin method. The temperature reached normal in a week and the wound was entirely healed in one month. The x-ray was negative on admission and one month later only a slight area of rarefaction marked the site of the inflammation. When seen ten months later, the wound had remained healed and the x-ray showed no evidence of the previous osteomyelitis.

Girl, fifteen months old, has had furunculosis and has been unable to walk for a week. On admission, marked swelling of limb from knee to toes. Point of maximum tenderness apparently over lower end of fibula. Temperature 103.4 degrees, blood count—leucocytes 8,000, sixty-five per cent. polynuclears. Operation: Lower end of fibula exposed, periosteum normal but incised, bone drilled but no pus obtained. Lower end of tibia exposed, periosteum thickened and slightly elevated, incised, bone drilled

and several drops of pus escaped. Second hole drilled one-half inch above first and intervening cortex removed. Culture, non-hemolytic streptococcus. Carrel-Dakin treatment. Temperature reached normal in three days and wound was healed in three weeks. Early x-ray negative. One week after operation, the report was an osteomyelitis of the lower third of the tibia with a small area of destruction.

Boy, nineteen months old: Two weeks ago child caught cold and neck became swollen. Three days ago became feverish and mother noticed a swelling about the lower end of the right humerus. On admission, temperature was 103 degrees, blood count—leucocytes 20,000, polynuclears eighty-eight per cent. Right arm, elbow and forearm swollen, red and tender. Operation: Incision two inches long above inner condyle of humerus, periosteum not raised, incised and bone drilled but no pus found. While stripping back periosteum preparatory to making drill hole nearer epiphysis, one ounce of thick pus escaped. Point of perforation not found and bone not drilled again. Wound in soft parts treated by Carrel-Dakin technique. Culture, streptococcus hemolyticus. Temperature reached normal in one week. X-ray ten days after operation reported early stage of osteomyelitis, characterized by elevation of periosteum at junction of middle and lower thirds of humerus. Patient discharged in one month with wound healed and slight limitation of flexion at elbow.

These three cases illustrate what we hope to obtain by early diagnosis and conservative surgery. The x-ray is always negative in the early stages of an acute osteomyelitis and diagnosis must be made on the acute onset, constitutional symptoms and local findings. If in doubt, explore, as no harm is done if exploration is negative. A few drill holes into the medulla at site of infection, usually in the metaphysis, give sufficient drainage, with liberal incision of the periosteum and soft parts. If the pus has ruptured through the cortex and periosteum into the soft parts and the child is very ill, it may be wise not to attempt to find the origin of the infection. Adequate drainage of the soft parts may be sufficient, relying on Nature's perforation to drain the bone and periosteum.

Dr. A. Krida—Bilateral Paralytic Calcaneus—Astragalectomy Right.

Dr. Krida presented a boy now twelve years of age, who had been admitted to the hospital sixteen months previously with bilateral paralytic calcaneovalgus of five years' duration. The distribution of the paralysis was rather remarkably symmetrical, the muscles of both hips and thighs being in general active and efficient. Below the knee, on the right side, there was paralysis of the calf muscle and of the tibialis anticus. On the left side, there was nearly complete paralysis of the calf muscle, and complete paralysis of both tibials. The left foot, therefore, presented more lateral deformity than the right. The gait was the characteristic heel-walk of calcaneovalgus. The foreparts of both feet were underdeveloped. The complaints associated with the condition were instability and frequent falls, due to pitching forward easily. On the right side, astragalectomy with backward displacement of the foot (Whitman operation) was done; on the left side, subastragalar arthrodesis. The opportunity for a comparison of the functional results of these two operations was somewhat unique, since the conditions in both feet were nearly identical, the condition in the left foot being somewhat more favorable than in the right, because of the persistence of a certain amount of power in the calf muscle. Function had improved very much. The right ankle (astragalectomy) presented about twenty-five to thirty degrees of movement; dorsal flexion was securely checked at a right angle. The left foot was symmetrical; there was ankylosis in the subastragaloid joint; the range of movement in the tibiotarsal joint was not affected; and the calcaneus element of the original deformity persisted practically unchanged. According to the patient's account, the right foot (astragalectomy) was the more secure of the two, since it enabled him to thrust his weight forward through the front part of the foot in walking and climbing stairs. He no longer pitches forward.

Dr. P. C. Colonna—Arthrodesis of the Shoulder for Poliomyelitis.

Dr. Colonna presented the case of a girl, aged twelve. History is that at the age of three, she had an attack of infantile paralysis and on admission to the hospital, presented

paralysis of the right deltoid. The other muscles of the upper extremity were weak but active, and in July 1927, an arthrodesis of the right shoulder joint was done, employing the Steindler technique. At the present time, there is firm bony ankylosis, right angle attitude of abduction and patient is able to elevate the arm sufficiently to comb the hair. This technique is recommended on account of its simplicity and complete exposure of the articular surfaces of the joint.

CONFERENCE OF FEBRUARY 23, 1928.

The President, Lewis Clark Wagner, in the chair.

DR. P. W. ROBERTS—A Case Illustrating Arthrodesis of the Hip.

Dr. Roberts reported this case to illustrate a new and simplified procedure to secure ankylosis of the hip joint. The patient was a man of fifty-four with an unilateral osteo-arthritis of the hip joint. In spite of the fact that he had only ten per cent. normal motion in the joint, he had worked for several years as a stevedore, but was eventually obliged to give up the job on account of pain. The hip joint was exposed through a Smith-Petersen incision. A tapered block of bone about one inch wide on its superior surface was removed from the upper part of the posterior surface of the acetabulum. After denuding this piece of its articular cartilage, it was temporarily put aside in salt solution. The leg was then put in the desired position of about fifteen degrees of abduction and held by an assistant. The slot in the acetabular rim was then carried down into the head of the femur, care being taken to maintain the slopes of the sides of the cut surfaces. The block removed from the acetabular overhang was then driven with force across the joint surfaces; the wound was closed in the usual way and a plaster spica applied. At the end of seven weeks, the patient was discharged from the hospital, wearing a short spica and using crutches. He was directed to return to the clinic three weeks later for removal of the cast. He appeared as requested, apologizing for taking the plaster off at home as he wished to come down in the subway to save taxi fare. Examination showed the hip to be firmly ankylosed and the patient free from pain. The simplicity and efficiency of the operation suggests its use in cases where ankylosis of the hip is desired and where the time element is an important factor.

DR. P. C. COLONNA—Fracture of Neck of Femur in Children. Six Cases.

Dr. Colonna presented a report of six cases of fracture of the neck of the femur in children that had occurred on the Children's Service at Bellevue Hospital during the past ten years. All these cases gave a history of violent trauma as the cause, and presented relatively little disability as result of fracture, several being able to walk into the clinic. All the cases had been treated by the Whitman abduction method and bony union had resulted in all. The majority were of the cervicotrochanteric type. In only one case was there a fracture of the transcervical type. It was suggested that support should be continued for three months in the transcervical type and two months in the cervico-trochanteric type of fracture, in these children, and that early weight-bearing was to be strongly condemned.

DR. R. C. KAHLE—Osteomylitis of Patella (Luetic in Origin).

Dr. Kahle presented the case of B.F. aged thirty-eight, who four years ago noticed a swelling on the outer side of the knee cap of the right lower extremity. This swelling shifted to the inner side a few months later, was painless, no limitation of motion. He had been receiving some osteopathic treatments two years after the beginning of the swelling with no relief. About one and one-half years ago, he slipped while walking on sidewalk and struck his right knee against the sidewalk. A few months later he noticed an ulcer forming for which he sought relief. There was no pain at the time of the ulcer formation. Past history: had a hernia operation in 1919. Denies genito-urinary diseases. Family history is negative as far as patient knows. Examination on August 30, 1926, revealed an ulcer one-half inch in diameter over the anterior lower half of the right patellar region. It rested upon an inflamed area about one and one-half inches in diameter. No tenderness. The patella itself felt about twice as large as normal. There was no increase in the fluid in the knee joint. No limitation of motion. Diagnosis

of infected prepatellar bursa or gumma was made. The Wassermann test was four plus. X-ray showed a negative knee joint, but a definite ridge in the lateral view on top of the patella. This ridge was about three-quarters of an inch long and one-eighth of an inch above the surface of the patella, and ran to a point at its lower extremity. Antiluetic treatment of neosalvarsan, mercury inunctions of mercury salicylate and bismuth had been carried on for one and one-half years and Wassermann test at the present time is one plus. X-rays taken on February 28 show a definite absorption of part of this ridge. The ulcer healed after specific treatment about three weeks and shows no residue. The points of interest are the rarity of syphilis of the patella and definite absorption of portion of the osteitis reaction of the patella.

CONFERENCE OF MARCH 22, 1928

The President, Lewis Clark Wagner, in the chair.

DR. R. WHITMAN—Reconstruction Operation for Legg-Perthes' Disease.

Dr. Whitman presented a case illustrating the operative treatment of Legg-Perthes' disease to supplement the one demonstrated at a previous meeting. The patient, a rather pale overweight girl, twelve years of age, was first seen in December, 1927. According to the history, she had been well until six months before that time, when on rising from a chair, there was sharp pain in the hip, increased by weight-bearing. She was placed in bed and remained there, suffering more or less from discomfort supposed to be caused by rheumatism. The acute symptoms subsided, but the limp persisted and for this reason she was brought to the hospital. It was noted that the left limb was extended and slightly adducted, that all movements of the joint were restricted and that there was discomfort on forced movement. The x-ray picture showed an epiphysis, irregular in outline, and much diminished in depth. From the history of the sudden onset, it seemed probable that the primary cause of the symptoms was a displacement of the epiphysis, but on opening the joint, the head presented the typical appearances of Legg-Perthes' disease. There was no other apparent pathological change except a thickened and congested ligamentum teres. The distorted head was removed, the extremity of the neck moulded into a smooth, rounded extremity and the trochanter transplanted in the usual manner. The novelty of the treatment in these cases was of less interest than the specimens, the examination of which had indicated apparently the true nature of the process. The first specimen had been described in great detail by Dr. Zemansky in the American Journal of Surgery for February (IV, 169, Feb. 1928), and the second, although of less advanced type, corresponded to it in all essentials. In brief, the process was a primary necrosis of the epiphysis, caused apparently by defective blood supply. Then followed secondary absorption of the dead bone and its replacement by fibroid tissue, collapse of structure and deformity. The articular cartilage, in spite of the distortion, retained its vitality, in distinction to the epiphyseal cartilage which was for the most part destroyed. It would appear, therefore, that there was no anatomical or pathological correspondence between this condition and epiphyseal fracture or displacement, as had been suggested. In the latter instance, the undistorted head was displaced to a greater or less degree upon the neck, carrying with it the conjugal cartilage. If it were promptly and accurately replaced and protected for a sufficient time, permanent recovery was the rule. The Legg-Perthes' disease entailed destruction of the substance of the head and the nature of the process seemed to support Legg's conclusion, from the observation of patients through a period of years, namely: that the final result was but little influenced by the character of the treatment. It would seem that the degree of final disability was dependent on the character of the deformity and upon the secondary changes that it induced in the articulation. For this reason, the reconstruction operation might be indicated, if warranted by the physical signs, to relieve the immediate symptoms and to insure the patient from future disability.

DR. CARL G. BURDICK—Central Fractures of Acetabulum—Two Cases.

Dr. Burdick presented two cases of central fracture of the acetabulum. The first, a patient fifty-eight years old, was hit by a taxi-cab the day before admission. The

x-ray showed head of femur had been pushed through the acetabulum with inward displacement of the floor of the acetabulum. Under general anaesthesia it was impossible to reduce the head of the femur by manipulation. A Steinmann pin was inserted through the great trochanter and twenty-five pounds lateral traction applied. Two days later, the x-ray showed that the head of the femur had been replaced in its normal position. The wound became infected and the pin had to be removed at the end of two weeks. Although traction was applied to the limb, there was slight recurrence of the deformity and the patient was discharged with one centimeter shortening.

The second patient was sixty-four years of age and fell about ten feet off a ladder, striking on the right hip. The x-ray showed a central fracture of the acetabulum with inward displacement of the head of the femur. Reduction was not possible by manipulation and a Steinmann pin was inserted through the great trochanter. Twenty-two pounds lateral traction was applied and three days later the x-ray showed the head of the femur in its normal position. The wound became infected and the pin was removed at the end of two weeks and the limb was put up in plaster in extreme abduction. Subsequent x-ray showed no recurrence of the deformity. While most of these central fractures of the acetabulum can be reduced by manipulation and abduction by prying the head out with the trochanter against the margin of the acetabulum as a fulcrum, a certain number of failures will be recorded.

In these cases insertion of a Steinmann pin through the trochanter with lateral traction will usually be successful in reducing the deformity. Due to the fact that the posterior end of the pin of necessity rests on the bed, the soft parts are injured and infection is very probable. As soon as the deformity has been reduced by traction, we would suggest removal of the pin and applying a plaster spica with the limb in extreme abduction.

DR. B. L. COLEY—Osteitis Fibrosa Cystica—Pathological Fracture of Neck of Femur.

Dr. Coley presented the case of H. G., age thirteen, a schoolboy. Admitted to the hospital on January 8, 1926. Past history—scarlet fever, measles and pneumonia. Family history negative. Chief complaint—pain in left thigh. Present history: One and one-half years ago patient first noticed pain in the left thigh. No direct trauma is recalled. Five weeks prior to admission, while walking along the street, he tripped and fell. He could not walk nor stand on the left foot. He was taken to the Lenox Hill Hospital where he was told he had a fracture and received baking. He was referred to this Hospital for further treatment by Dr. Fischer. Physical examination shows a rather obese intelligent boy of thirteen, weighing ninety-three pounds. Examination by systems showed no abnormality except for the local condition. The left lower extremity was held in a position of external rotation with marked eversion of the foot. Any motion of the extremity elicited pain referred to the left hip. Palpation of the groin and hip failed to reveal any evidence of soft-part or deep bony swelling. Laboratory findings: blood Wassermann, negative; urinalysis: no albumen, no sugar, no casts. Temperature was normal on admission. X-rays were taken which showed a destructive process in the neck of the left femur involving part of the great trochanter. Extending through this involved area there was a pathological fracture and the position was that of a moderate coxa vara. A tentative diagnosis of osteitis fibrosa cystica was made, although the possibility of a bone sarcoma was also entertained. Five days after admission, the patient was put up in a plaster spica in abduction and internal rotation. X-rays taken after removal of this cast ten weeks later showed callus formation and signs of union. Thereafter, the patient was allowed to sit up in a wheel chair daily for three weeks, when crutches were ordered. One month later, patient was discharged in a walking Thomas splint, which was discarded three months later and the patient has repeatedly returned for observation. There is one centimeter of shortening, no limp and no disability.

Current Literature

MUSCLE FUNCTION. By Wilhelmine G. Wright. New York, Paul B. Hoeber, Inc., 1928, $3.50.

We have now another book on muscle function, and this time the study is upon the living human being, taking the place of the study of muscle action upon the cadaver or of muscle action by means of faradic stimulation, as in many previous text-books.

There are many authorities on muscle function and few that agree. Miss Wright quotes from many, but it is Beevor and Duchenne that are most freely discussed in this book. The various reasonings of Beevor and Duchenne are placed before the student while Miss Wright gives her reasons for agreeing or for disagreeing, according to her experience and observations in the handling of large numbers of poliomyelitis patients having paralyzed or partially paralyzed muscles, also upon muscle action from a study of muscular movements of normal individuals. Miss Wright speaks of Beevor's method of investigation as the physiological or natural method in which, she explains, a person is told to perform a definite movement and it is then observed which muscles take part in the movement; she says that by this method one can tell not only "what a muscle may do" but "what a muscle does do".

Miss Wright explains that she set about the task of trying to do for the lower extremity what Beevor had so ably done for the upper, then she completed her task by testing the movements of the upper extremity in the hope that it might throw a little more light on some of the problems that Beevor had not satisfactorily solved by his method of investigation.

The first chapter is entitled General Principles of Muscle Action; it is divided into leverage, synergic muscles, two-joint muscles, antagonists, group enervation, and the timing of muscles. It will be observed by the sub-divisions of this chapter that the author outlines the subject in a very comprehensive manner, and throughout the reader feels assured that the author's discussions are based upon a thoroughly sound understanding of the neuromuscular structures; that she is a keen observer, with a great deal of experience in the care of normal muscles, paralyzed muscles and muscles that have undergone operation for transplantation Miss Wright's observations upon transplanted muscles are that reeducation in these cases takes a longer time and more patient teaching in muscle training than muscles normally recovering from poliomyelitis. The individual movements of the muscles of the upper and lower extremities are fully discussed, as well as movements of the spine and the muscles of breathing. The last chapter gives a tabulated list of muscles involving the different joints of the body, stating in each case whether the muscle in question acts as a prime mover, synergist, or as an emergency muscle.

In the 175 pages of this book there is much discussion, observation and information regarding muscle function which should prove valuable to persons making a special study of muscle training, myology or kinesiology.

The *Journal* wishes to acknowledge the receipt of the following books sent to the Editorial Department:

Corrective Physical Education for Groups. By Charles L. Lowman, M.D., Claire Colestock and Hazel Cooper. New York, A. S. Barnes & Co., 1928.

Die körpereigene freie Fascienverpflanzung. By Dr. Ernst König. Berlin, Urban & Schwarzenberg, 1928.

First Aid and Medical Service in Industry. Compiled from a survey by Dr. H. L. Daiell. New Brunswick, N. J., Johnson & Johnson, 1928.

Die Technik des Orthopädischen Eingriffs. By Dr. Philipp J. Erlacher. Vienna, Julius Springer, 1928.

Giornale Medico dell'Ospedale Civile di Venezia, Venezia, Vol. II, No. 2, April, 1928.

Deutsche Monatsschrift für Zahnheilkunde, Berlin, Vol. XLVI, Part 2, January, 1928.

Slovanský Sborn´k Ortopedický, Brno, Czecho-Slovakia, Vol. III, Nos. 1 and 2, 1928.

Revista de la Asociacion Medica, Argentina, Buenos Aires, Vol. XLI, Nos. 265 and 266, January and February, 1928.

Norsk Magazin for Laegevidenskapen, Oslo, Vol. LXXXIX, Nos. 4 and 5, April and May, 1928.

THE ROENTGEN-RAY DIAGNOSIS OF INFANTILE SCURVY. Ralph S. Bromer. *Am. J. Roentgenol.*, XIX, 112, Feb., 1928.

An extremely interesting and instructive paper showing conclusively that it is comparatively easy to diagnose scurvy in its early stages. The article is very well illustrated. The clinical manifestations, pathology, and microscopic pathology as well as the roentgenological changes are gone into very carefully.

From the roentgenological standpoint, the disease is divided into four stages. Differential diagnosis from sarcoma and rickets is carefully gone into. Fifty-six cases are reported: thirteen in the first stage, thirty-three in the second, nine in the third, and one in the fourth. In the earlier stages, the clinical diagnosis had only been made in a comparatively small percentage of the cases.

The paper shows that there are definite epiphyseal changes in scurvy and thereby corrects the error that is found in text-books of roentgenology that scurvy can be distinguished from rickets by the fact that in scurvy there are no epiphyseal changes. *Edward S. Hatch, M.D., New Orleans.*

OSTEOCHONDRITIS DISSECANS. G. E. Richards. *Am. J. Roentgenol.*, XIX, 278, Mar. 1928.

This is a very interesting and timely article and well worth reading in its entirety.

The knee joint is a common location for the disease and from the excellent radiographs shown, it is possible to diagnose this condition before the sequestrum becomes a "loose body".

One case of a similar condition in the hip joint is described. The author sums up as follows:

"The common features include the following:

"(1) A localized area of destruction within a joint, accompanied by the separation of a hard, fibrous sequestrum.

"(2) In the knee joint the location is always on the same site, *viz;* outer side of inner condyle opposite to the tibial tubercle.

"(3) The mesial tubercle of the tibial spine in a majority of cases is unusually long.

"(4) In other joints where the lesion has occurred it has been only in exposed positions and there has been a history of traumatism.

"(5) The lesion is sharply defined, punched out, with very well outlined borders and there is complete absence of the roentgen signs of inflammatory or infective origin to account for this.

"(6) The joint proper is not involved.

"Finally it may be proper to add as an extra reason, if such be needed, for early and accurate recognition of the condition, that surgical removal almost invariably results in a radical cure of the disease."—*Edward S. Hatch, M.D., New Orleans.*

THE TREATMENT OF COMPOUND INJURIES OF THE EXTREMITIES. John H. Garlock. *Ann. Surg.*, LXXXVII, 321, Mar. 1928.

This is a difficult article to summarize as it covers a large territory very concisely. There are numerous case reports with excellent illustrations and radiograms. He emphasizes early operation, thorough cleansing of the parts involved, careful debridement. One should carefully bear in mind the possibility of gas gangrene where there is extensive muscle injury. He uses the Carrel-Dakin technique and secondary suture, or various methods of skin grafting. Special attention is given to restoration of function. As much tissue is conserved as possible, especially in the upper extremity. A few indications for amputations are given, with some rules to be observed. The report is from the second division of the New York Hospital where a large number of these cases are treated.

Fred G. Hodgson, M.D., Atlanta, Ga.

THE ABDUCTION TREATMENT: A STANDARD PROCEDURE FOR ALL FORMS OF FRACTURE OF THE HIP JOINT. Royal Whitman. *Ann. Surg.*, LXXXVII, 442, Mar. 1928.

Everyone knows Dr. Whitman's excellent method of treating fractured hips. He says it is the only method practical for elderly and aged patients, it is the only method by which resistant deformity may be definitely corrected, it is the only method by which security of apposition essential to repair of the transcervical fractures may be assured. He mentions various methods and modifications but condemns them all. In cases which fail to unite he advises the Whitman reconstruction operation.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

PRIMARY SARCOMA OF THE CLAVICLE. Lewis Barclay Bell. *Ann. Surg.*, LXXXVII, 382, Mar. 1928.

A case is reported where the entire clavicle was excised and the patient is alive and well after three years. The pathological report is attached. The literature of this condition is added.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

SUSPENSION OF THE FOOT IN TREATMENT OF POTT'S FRACTURE WITH PERSISTENT POSTERIOR DISLOCATION OF THE ASTRAGALUS. John C. A. Gerster. *Ann. Surg.*, LXXXVII, 450, Mar. 1928.

One case is reported in which two attempts to reduce under anaesthesia and plaster cast had failed. The foot was suspended on the fifth day by a strip of adhesive plaster applied to the sole and posterior aspect of the heel. The reduction was excellent. The foot was elevated and fixed, the natural weight of the leg was sufficient to maintain reduction. Proper adjusted suspension under the knee prevented hyperextension. Free active dorsal and plantar flexion of the ankle was practised. Suspension for five weeks followed by physiotherapy. Patient seen three years later, had no disability.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

FRENCH HEEL FRACTURES OF THE TARSAL SCAPHOID. V. W. Murray Wright. *Ann. Surg.*, LXXXVII, 587, Apr. 1928.

Anatomically this is a sprain-fracture of the superior surface of the tarsal scaphoid, affecting the anterior capsular ligament of the ankle joint, the superior astragaloscaphoid ligament and the dorsal scaphocuneiform ligament. Occasionally a small fragment of bone is detached from the anterior surface of the astragalus, or the posterior portion of the superior aspect of the cuneiform. The fragment varies in size from that of a pea to half the size of a cherry. The cause, in the majority of the cases, has been due to hyperextension (plantar flexion) of the foot upon the ankle joint accompanied as a rule by some inversion or eversion. *Eighty per cent. have occurred in females wearing high heeled open slippers* or *pumps*, hence the name. Treatment: Adhesive "stirrup" maintaining dorsal flexion. Wear low heeled oxfords. Adhesive worn for three weeks—after this an elastic ankle support may be worn. Sone clinical notes are added.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

THE PROPHYLAXIS OF GAS GANGRENE IN CIVIL SURGERY. Morris Joseph. *Ann. Surg.*, LXXXVII, 772, May 1928.

Attention is called to the fact that many cases, such as compound fractures with extensive muscle injury, especially those occurring on the streets and due to automobile and other severe mechanical agencies, may develop gas gangrene. The perfringens serum, or a polyvalent serum should be used as a prophylactic in such accident cases, where one has reason to suspect that gas gangrene may develop.

Two cases of severe injury developing gas gangrene are reported. They both recovered under surgery combined with the use of perfringens serum.—*F. G. Hodgson, M.D., Atlanta, Ga.*

CONGENITAL DEFECTS OF THE FEMUR. Harald Nilsonne. *Arch. f. Orthop. u Unfall-Chir.*, XXVI, 138, 1928.

The author gives a classification of the congenital femoral defects which is a modification of that of Reiner and Drehmann, as follows:

1. The diaphysis is affected, there being a marked shortening of the femur. It is a congenital hypoplasia.
2. The upper half of the femur is mainly affected. The knee is developed.
   (a) There is coxa vara with extreme shortening.
   (b) The lower epiphysis and lower diaphysis are developed and possibly the head and greater trochanter, but the main portion of the shaft has ossified to a unit. Extreme coxa vara is found in the terminal stage of development.
   (c) The lower epiphysis and lower diaphysis have developed and possibly the head and greater trochanter, but there is no later ossification.
3. The development is defective with the hip and knee in the embryonic condition.
   (a) The hip is not differentiated, there being a synostosis between the head and the acetabulum.
   (b) The knee is not differentiated, there being a synostosis between the lower femur and tibia.
4. Complete absence of the femur.

The author reports ten cases of congenital femoral defects with excellent roentgenograms, showing in each instance the points of differentiation. These cases have all been placed in one of the above groups. He states that there are eighty-two reported cases in the literature including these ten cases of his own. They are about equally divided as to sex. The right side has been affected slightly more than the left. Fifteen of the eighty-two cases show bilateral femoral defects. The most frequent type of the condition falls in Group 2 (c). He states that it is extremely doubtful as to whether there is ever a complete or total absence of the femur, however there have been three cases reported. Fifty-four cases show other congenital defects. It has been noted that the more extreme the femoral defect is, the more liable are there to be associated other congenital defects. Twenty-seven cases showed a defect of the fibula. Thirty-one cases showed a patella defect. A congenital dislocation of the hip on the opposite side has been noted once. There have been associated defects of the pelvis noted. Many theories have been advanced to explain the etiology. The author believes that there is a vascular disturbance in the anlage of the ossifying femur, caused by pressure from the amnion, either in the form of amniotic bands or adhesions, or from the amniotic sac being too small. In some cases the possibility of intra-uterine fractures cannot be excluded. The author believes that any form of treatment which may be indicated should be instituted early in childhood. If weight-bearing is to be allowed with the aid of an artificial limb, this should be done early because of the stimulation of the growth of the tissues. Usually the stability of the hip in these cases is good. Sometimes extension and operations to reduce contractures of the hip and knee are indicated. It has been found that after osteotomy in these cases there is normal callus and new bone formation. The author has referred to all important articles in the literature on this subject, and has analyzed many of these in detail.—*Thomas M. Foley, M.D., Washington, D.C.*

THE ETIOLOGY AND TREATMENT OF SCOLIOSIS. Joseph I. Mitchell. *Arch. Surg.*, XVI, 680, Mar. 1928.

Reviewing 125 cases of scoliosis observed in the Willis C. Campbell Clinic from 1919 to 1927, Mitchell pays particular attention to the results of treatment in the thirty-six patients who presented themselves in the last three years. His figures on the etiology are very much like those that have been obtained in all large clinics. In the matter of treatment, while there is stressed the importance of adaptation of the method used to the individual case, there is, nevertheless, a distinct swing toward the operative type of treatment, namely, fusion of the spine. After careful pre-operative correction, fusion of the spine, with preference given to the osteoperiosteal graft, is recommended.—*I. Wm. Nachlas, M.D., Baltimore, Md.*

MYOSITIS OSSIFICANS. Thomas R. Chambers. *Arch. Surg.*, XVI, 755, Mar. 1928.

Chambers reports another case of myositis ossificans which was followed over a period of four years. Although there was no direct blow there is a history of indirect violence. Steady, painful growth persisted for twenty months. Following removal the mass recurred. Amputation was necessary. In the differential diagnosis sarcoma had to be seriously considered.—*I. Wm. Nachlas, M.D., Baltimore, Md.*

RELATION OF THE PARATHYROIDS TO THE HEALING OF A FRACTURE AS CONTROLLED BY THE ROENTGEN RAYS. Dudley E. Ross, *Arch. Surg.*, XVI, 922, Apr. 1928.

By excision of varying amounts of parathyroid tissue and artificial fracture of long bones, Ross is able to determine the value of these glands in the healing of fractures. He finds that the removal of less than three parathyroids does not delay bony union, nor does it interfere with the blood-calcium level. The excision of three parathyroids lowers the blood-calcium by two or three milligrams per 100 cc. of serum and makes an appreciable delay in bony union. The phosphate level was not affected by the removal of three parathyroids.—*I. Wm. Nachlas, M.D., Baltimore, Md.*

MULTIPLE MYELOMA. Charles F. Geschickter and Murray M. Copeland. *Arch. Surg.*, XVI, 807, Apr. 1928.

In a very comprehensive article there is presented a history of multiple myelitis and a statistical study of 425 cases recorded since 1848. Thirteen cases studied in the laboratories of the Johns Hopkins Hospital are reported.

Six cardinal features of myeloma are enumerated: multiple involvement by tumor of the skeletal trunk, pathological fracture of a rib, Bence-Jones bodies in the urine, intermittent backache with early paraplegia, anaemia and chronic nephritis with low blood pressure.

The article is well illustrated with charts, roentgenograms, and microphotographs. —*I. Wm. Nachlas, M.D., Baltimore, Md.*

MAJOR AMPUTATIONS. John Kuhns and Philip D. Wilson. *Arch. Surg.*, XVI, 887, Apr. 1928.

At the Massachusetts General Hospital 420 major amputations were performed from 1916 to 1926. These are studied and analyzed. Aside from the usual statistical figures the article gives valuable information in matters which have been a subject of much controversy. It is pointed out that drains are often used needlessly and are responsible for persisting sinuses. The value of temporary prostheses is brought out particularly with reference to thigh amputations. The Syme amputation was found to yield excellent results while in amputations necessary for vascular disease the Gritti-Stokes operation gave best functional results. Because of the large number of cases studied and because of the thoroughness of the analyses the article is a valuable addition to our information on amputations.—*I. Wm. Nachlas, M.D., Baltimore, Md.*

PYOGENIC ARTHRITIS IN THE KNEE JOINT OF RABBITS. A. R. Shands, Jr. *Arch. Surg.* XVI, 1039, May 1928.

Knee joints in rabbits are experimentally infected with staphylococcus aureus. After clinical manifestations of active infection present themselves, sterilization of the joints is attempted. The antiseptic used is gentian violet dissolved (1) in distilled water, (2) in a four per cent. dextrose, or (3) in olive oil. Gentian violet is used in two strengths, first, one-quarter of one per cent. and, second, one-half of one per cent. The knee joints are studied bacteriologically, clinically, roentgenologically, and pathologically. It was found that eighty-five per cent. of the infections could be controlled by the use of gentian. The more quickly sterilization took place the fewer joint changes were noted. The most efficient medium for the gentian violet was the four per cent. dextrose. The joints treated by one-half of one per cent. solution of gentian gave better results than those treated by one-quarter of one per cent. The experiments were performed on thirty animals. Protocols of these experiments are appended.—*I. Wm. Nachlas, M.D., Baltimore, Md.*

LIVING SUTURE GRAFTS IN THE REPAIR OF FRACTURES AND DISLOCATIONS. Arthur W. Allen. *Arch. Surg.*, XVI, 1007, May 1928.

The value of fresh autogenous fascia lata grafts in the repair of certain bone lesions is brought out by a report of the use of such sutures in sternoclavicular dislocations, fractures of the patella, fractures of the olecranon, and anterior subluxation of the radial head. The technique used is fully described and adequately illustrated.—*I. Wm. Nachlas, M.D., Baltimore, Md.*

KÜMMELL'S DISEASE. J. Cardis, G. F. Walker and R. H. Olver, *British J. Surg.*, XV, 616, Apr. 1928.

This disease, first described by Kümmell in 1894, is defined as the delayed crumpling collapse of the body of a vertebra following injury. The *injury* may be due to direct injury to the back, to a fall from a distance, or to a mere jarring of the spine by jumping from a moving vehicle. The *post-traumatic symptoms* may be mild or severe with paralysis. The *latent period* may be from days to years. There may be a long period during which the patient is able to work before the onset of the final symptoms. The *return of the symptoms* is manifest at first locally as pain, tenderness, or weakness. The *fifth stage* calls for orthopaedic measures in the absence of which there is a progressive crush of the cord.

The treatment consists in extension of the spine on a Bradford frame, support of the spine by a corset or jacket worn for a long period, and occasionally a bone graft. The prognosis "would seem to be very good". "If a man is back at work within two years from the original injury, he is very fortunate, and so are his advisors."

Thirteen cases are reviewed. Kümmell's original cases are also summarized.

PATELLA CUBITI. George Gunn. *British J. Surg.*, XV, 612, Apr. 1928.

A case is cited of a woman who sustained a severe injury to her elbow, diagnosed as a fracture. Four days later x-rays showed a separation of the olecranon, but the edges of the fragments were smooth and rounded. Four months later, flexion, pronation, and supination were normal and extension to 160 degrees was present. At this time the fragment was still movable and, on relaxation of the triceps, closely resembled the patella.

The literature on the subject is reviewed. There are occasionally several centers of ossification of the olecranon. Apparently this case represents a persistently separated center of ossification. As the patella is a new-formed cartilage in a tendon, there can be no analogy between the patella and the fragment mentioned in this case.

HALLUX VALGUS. Merrill C. Mensor. *California and West. Med.*, XXVIII, 341, Mar. 1928.

The author has studied forty-one cases of hallux valgus in the orthopaedic clinic of Stanford University, and has evidence to support the idea of congenital origin of this deformity. The most important finding is that a number of the patients showed a varus angulation of the first metatarsal and the children of some of these patients showed the same deformity. The cuneiform joint with the first metatarsal is set at an angle which sends the metatarsal off at a varus angle. The great toe is then pushed over into a valgus angle by pressure of the shoe. In one case, this deformity extended through three generations.

Many patients have no symptoms until the fourth or fifth decade of their life when they begin to have pain. The pain and not the deformity brings the patient to a doctor. Usually the joint is arthritic which may explain the pain coming on later in life.

In treatment, it is best not to operate on such a joint if definite arthritis is present. For the cases with bad varus angulation of the metatarsal, an osteotomy should be done on this bone at its base, as advocated by Ewald, and the metatarsal straightened. —*W. A. Clark., M. D., Pasadena, Calif.*

THE ROENTGEN DIFFERENTIATION OF BONE TUMORS. W. B. Bowman and L. S. Goin. *California and West. Med.*, XXVIII, 470, Apr. 1928.

Baetjer's four cardinal points are valuable for differentiation:

1. Origin. Tumors arising from the cortex are: periosteal sarcoma, osteosarcoma, enchondroma and rarely, cysts; from the medulla: medullary sarcoma, carcinoma, cysts, giant-cell tumor, enchondroma.

2. Bone production or bone destruction. Production occurs in periosteal sarcoma, osteosarcoma, osteoma, bone cyst. Destruction occurs in all sarcomas, carcinomas, cysts, myelomas, giant-cell tumors.

3. Condition of cortex. Giant-cell tumors, enchondromas and cysts cause expansion and thinning of the cortex. All types of sarcoma and carcinoma destroy the cortex.

4. Invasion of soft tissues. All malignant tumors invade the surrounding tissues; benign tumors do not.

Periosteal sarcomas arise most commonly at the ends of long bones, chiefly the tibia, femur and humerus. The earliest sign is a slight depression in the cortex and a thin plate of bone extending out at right angle to the long axis of the bone. It may invade an adjacent joint.

Osteosarcoma may cause both bone production and bone destruction. The more malignant the growth, the less bone production. Destruction of the shaft is common.

Medullary sarcoma is a very malignant type and a purely distinctive process. It can not be differentiated from carcinoma by the roentgenogram alone. It does not have a regular outline as does myeloma.

Carcinoma is most common in the middle third of the shaft. Frequent sites are ribs, spine, pelvis, femur, and humerus. Metastasis from carcinoma of the breast practically never occurs in the bones of the forearm, leg, hand, or foot. New bone is never seen. Complete destruction of a shaft, invasion of soft tissues, and pathologic fracture are characteristic. Well differentiated areas of rarefaction and areas of great density in the pelvis or spine are very suspicious of metastasis from prostate carcinoma.

Myeloma is most common in ribs, sternum, vertebra, skull, femur, pelvis, humerus, in the order named; always multiple, always destructive; causing multiple fractures, invading soft tissues.

Of the benign growths, the giant-cell tumor is usually in the ends of long bones. The order of frequency is: lower end of femur, upper end of tibia, lower end of radius. It starts in the medulla and grows rather slowly, causing bone expansion but no bone formation; thin shell, regular outline, inside trabeculae.

Cysts start in the medulla, most frequently in the humerus, femur and tibia. They

never pierce the cortex or the epiphyseal line. Growth spreads up and down the medulla, giving the shaft a spindle shape. There may be trabeculae but usually there is a single cavity.

Enchondromas are cartilaginous growths, usually multiple with well defined walls. It is difficult to distinguish a single enchondroma from a single cyst.

Osteoma is normal bone growing perpendicular to the shaft, sometimes cauliflower in shape.—*W. A. Clark, M.D., Pasadena, Calif.*

Postural Defects, Correctable in School Physical Education Classes. William Arthur Clark. *California and West. Med.*, XXVIII, 636, May 1928.

When large groups of children and young adults are examined, it is found that an appreciable percentage are abnormal in one or more aspects of body mechanics. Since this is a handicap, potential or real, such conditions should receive adequate treatment. However, the tendency in school to expect every child to conform to one type, should be guarded against.

A "vicious circle" in posture may be represented as follows: (1) slump in skeleton; (2) interference with organs; (3) poor function; (4) malnutrition and poor aeration; (5) depressed muscle tone which causes (1) slump in skeleton, etc.

Many cases of round shoulders have their origin in a tilted pelvis. When the pelvis is tilted forward, as a result of poor muscle tone around the hips and lower trunk, the consequent lordosis must be compensated by an exaggerated forward curve in the upper dorsal region which gives the rounded effect to the shoulders.

In evolving from the quadruped to the biped stage, the human skeleton seems to have a weak point remaining in the sacro-iliac joint. Perhaps in the distant future, further evolution may eliminate this joint and a solid bony union will preclude the now frequent trouble in this region.

In round shoulders, the most serious handicap is ptosis of the heart and diaphragm which are to a certain extent "hung" from the root of the neck. In growing children with tendency to this deformity, it is best to have the clothing held by a belt at the waist rather than hung from the shoulders by straps. The condition can easily be treated in corrective physical education classes by well trained physical education teachers. Active muscle development should be the goal rather than passive bracing of the shoulders by apparatus.

Scoliosis cases if not too severe, may be treated individually at school, provided the physical education department is properly supervised. The time-worn ideas regarding etiology of this deformity do not seem adequate in explaining it. It is suggested, with some evidence for support, that the lateral deviation may come from habits of sleeping—*e.g.*, on the same side with pillow under the head and shoulder. Certainly there is more time spent in sleeping than in writing at a desk or carrying books.

In the discussion of this paper, the point is raised whether any attempt should be made by physical education teachers to do such work as outlined above. In answer to this it may be said that the majority of the defects are minor in degree and would not justify regular trips to the orthopaedic surgeon. The whole problem presupposes adequate orthopaedic supervision to differentiate the cases.

Olecranon Bursitis. W. W. Lasher and L. M. Mathewson. *J. Am. Med. Assn.*, XC, 1030, Mar. 31, 1928.

Sharp blows on the elbow produce effusion in the olecranon bursa which may become infected through a small abrasion at the time of injury or from a needle puncture made for aspiration. Osteomyelitis is almost constantly associated with the bursitis because of the close relation of injured bone cells to the posterior wall of the bursae. Cases are reported to illustrate this pathology and to show the effect of early radical treatment. Complete excision of the entire bursa should be done early and if there is osteomyelitis, the bone curetted and the area phenolized. Delay in following this procedure caused a prolonged disability.—*W. B. Carrell, M.D., Dallas, Tex.*

STRUCTURAL SCOLIOSIS. Armitage Whitman. *J. Am. Med. Assn.*, LXXXIX, 2159, Dec. 24, 1927.

Extreme deformities, in scoliosis, are difficult to stabilize by the Hibbs fusion and need additional bone grafted against the laminae for reenforcement.

The author describes a method of obtaining the graft and at the same time lessening the unsightly prominence of the angulated ribs. The usual fusion operation is carried out in so far as it is practicable; then an exposure is made of the convex ribs, and three or more sections are removed subperiosteally and placed on the concave side of the curve. Nine patients have been operated on in this manner and the results have justified the operation. The fusion was good, the deformity improved, and constitutional effect definite and salutary.—*W. B. Carrell, M.D., Dallas, Tex.*

SCOLIOSIS. Frank Ober and Ralph Ghormley. *J. Am. Med. Assn.*, XC, 361, Feb. 4, 1928.

The author presents a brief summary of the etiology and treatment of scoliosis. The prognosis depends on the underlying cause, the general health, the character of curve, and flexibility. Moderate deformities may be improved by exercises and general care. In severe types mobilization is actually harmful unless apparatus and jackets are used to improve and hold the curve when it is flexible.

Operative treatment is indicated in rapidly increasing curves, when there are signs of general debility and ill health, rib pressure with intercostal or pelvic pain, and when there is inability to hold the curve in infantile paralysis.

Most curves in children should not be fused because the same factor exists after the operation to produce deformity and too frequently the rigid deviated spine is more deforming than before treatment.—*W. B. Carrell, M.D., Dallas, Tex.*

BUCKET-HANDLE FRACTURES OF THE SEMILUNAR CARTILAGES. Melvin S. Henderson. *J. Am. Med. Assn.*, XC, 1359, Apr. 28, 1928.

This type of cartilage injury is essentially a longitudinal tear in the cartilage and the loop attached both anteriorly and posteriorly is carried over into the intercondylar notch. The mechanism of injury is rotation inward of the body on a flexed and abducted knee. Extension of the knee in the abducted and rotated position will fracture the cartilage and the frequency of the bucket-handle type is approximately twenty-five per cent.

The symptoms are the same as in other types of cartilage injury: pain, swelling, tenderness, and recurrent lockings.

When the loop remains in the intercondylar notch, the anterior portion of it prevents full extension and the clinical findings of imperfect extension as a residual factor in convalescence should suggest the presence of this lesion.—*W. B. Carrell, M.D., Dallas, Tex.*

LOCAL DECALCIFICATION OF BONE AND BLOODLESS STRAIGHTENING OF CURVED BONES IN CHILDREN, AFTER THE METHOD OF RABL. S. Matrossov. *J. sovremennoi Chir.*, II, 1021, 1927.

Author reports ten cases of rachitic deformities of the lower extremities in which the Rabl method has proved very successful. The ages of the children were from two to four. They received 2 NH_4 Cl per kiloweight daily by mouth. The extremities were treated by Bier's hyperaemia applied centrally to the curved bone and left on from as long as eighteen to twenty hours a day. The effect was that in about two weeks the bones were so soft that they could be modelled manually and bloodlessly. After straightening the bones, the leg was encased in plaster-of-Paris casts and the children allowed to bear weight. They then received treatment to strengthen their resistance and to increase their calcium deficiency. Four weeks later the cast was made removable and in eight weeks after the first application, the child was allowed to go without any support. The treatment was carried out ambulatorily.—*A. Gottlieb, M.D., Los Angeles, Calif.*

CONGENITAL ARTHROGRYPOSIS. E. Osten-Sacken. *J. sovremennoi Chir.*, II, 919, 1927.

Five cases of congenital arthrogryposis are reported. On the basis of previous reports, which are fully reviewed, and the author's personal observations, he comes to the conclusion that this defect may be regarded as an adynamic contracture, which has formed as a result of abnormal muscular development, as well as from retarded functional differentiation of the joints, with the addition of heretofore unknown intra-uterine mechanical influences.—*A. Gottlieb, M.D., Los Angeles, Calif.*

THE CAUSE OF DEVELOPMENT OF HALUX VALGUS AND A NEW PHYSIOLOGICAL METHOD OF OPERATION. J. E. Hagen-Torn. *J. sovremennoi Chir.*, II, 789, 1927.

Reviewing in detail the pathological anatomy of this defect, the author explains the fallibility of all the advocated operative procedures, which have no sufficient physiological bases and are not in accord with the laws of statics and dynamics of the foot. The etiologic theories of halux valgus are rehearsed. The author believes that the mechanism of production of this deformity rests upon the action of the adductor hallucis. This muscle becomes contracted,—adduction contracture,—as a result of the combined influence upon the head of the first metatarsal of the adductor muscle which is in structure and function stronger than its antagonist, the abductor hallucis, and the narrow and pointed shoe with its weakening influence upon the same muscle, the abductor. The operation advocated consists in transplanting the abductor hallucis muscle from the attachment on the inner sesamoid to the head of the proximal phalanx. This will suffice to cure the halux valgus in mild conditions. In more severe cases, the author adds to this operation a cuneiform resection of the metatarsal shaft. For one week the foot is kept immobilized in a starch bandage; then the patient wears an arch support for two weeks longer. Sixteen cases have been dealt with in this manner and in fifteen the results were excellent.—*A. Gottlieb, M.D., Los Angeles, Calif.*

RESTORATION OF FUNCTION OF PARALYZED CALF GROUP BY MEANS OF MUSCLE TRANSPLANTATION. A. Jeletzki. *J. sovremennoi Chir.*, II, 797, 1927.

The author describes three cases of paralysis of the calf group muscles in which he restored function,—plantar flexion,—by transplanting muscles from above. The only functioning muscles below the knee were: tibialis anticus, in good condition; the extensor digitorum and extensor hallucis longus, weak; while all the rest of the muscles were paralyzed. The author transfers the muscle power of the biceps, semitendinosis and gracilis upon the calcaneus to which the strong silk tendon is securely attached. The silk cord is woven through the tendo Achillis to reach the tubercle of the os calcis. Besides this he attaches the tendo of the peroneus longus to the tendon of the tibialis anticus. In about one year the patients wore ordinary shoes and could discard any other supporting apparatus.—*A. Gottlieb, M.D., Los Angeles, Calif.*

THE SURGICAL TREATMENT OF RAYNAUD'S DISEASE AND SIMILAR CONDITIONS. N. D. Royle. *Med. J. Australia*, Supplement No. 11, 341, Nov. 5, 1927.

It has been shown that vasodilatation follows the operation of sympathetic ramisection. This is intense for several days, then gradually lessens, but is demonstrable as late as three years after operation.

Formerly, vasoconstricting disease was treated by periarterial sympathectomy. Recently it has been shown that the sympathetic nerves supplying the vasoconstrictors travel not along the blood vessels, but are given off from the segmental nerves at irregular intervals. At present, ramisection or ganglionectomy of the sympathetic nerves is practically the only line of treatment in use for Raynaud's desease and allied conditions.

Vasoconstrictor nerves are supplied by the sympathetics, and vasodilators apparently by nerves which travel along with the sensory nerves, but in opposite direction, through the posterior nerve roots.

Raynaud's disease is caused by over-sensitiveness to stimuli of the vasoconstrictor nerves.

The sympathetic nerve supplies reach the segmental nerves through the grey rami-communicans; hence to inhibit vasoconstriction it is necessary to divide the rami-communicans at their source. There is no need to remove the whole sympathetic trunk.

The result of ramisection in thrombo-angiitis obliterans is not so satisfactory: while the circulation is improved, the pain may persist. In Raynaud's disease the results are more satisfactory and permanent.—*Edward N. Reed, M.D., Santa Monica, Calif.*

THE PATHOLOGY OF OSTEO-ARTHRITIS OF THE HIP JOINT, AS SEEN AT OPERATION. Marian A. Radcliffe-Taylor. *Med. J. Australia*, Supplement, Oct. 29, 1927.

The paper considers mono-articular hip joint trouble, occurring in adults, with characteristic deformity of the head of the femur and characteristic symptomatology. Charcot's disease, syringomyelia, the end results of acute infective arthritis and the like are included.

The symptoms included: (1) Pain in the hip joint, the inner side of the thigh, and the knee:—the latter, at times, without pain in the hip; increased by standing, walking or any sudden movement, especially thigh rotation: (2) Stiffness, very gradually increasing. (3) The limp of an adducted and flexed limb. There is always a lumbar lordosis and external rotation, adduction, and flexion of the thigh; with limitation of movement in all directions, and muscle wasting. Attempts at inward rotation are painful.

Radiographically there are two types. (1) The head of a normal shape, but with a collar of new bone at the margin of the articular surface of the femur and to a lesser degree at the margin of the acetabulum. (2) Flattening of the femoral head like an umbrella, with the collar of osteophytes encroaching on the neck of the femur. In both there is increased density of the head and neck. This disease has been called malum coxae senilis, hypertrophic osteo-arthritis, degenerative arthritis, and arthritis deformans. It differs entirely from rheumatoid arthritis.

The author has studied the pathology of sixteen cases at operation. On incising the capsule, yellow fluid escaped, showing that the disease is not essentially a dry process. The synovial membrane over the anterior aspect of the femoral neck and lower portions of the acetabulum is of dusky red color, with a coarse, villous appearance, and is considerably proliferated. This is not true of the portion behind the femur. The cartilage over the posterior-superior weight-bearing surface of the head is usually worn away, leaving smooth eburnated bone. The remaining cartilage is dull yellow, turbid, non-translucent, rough and fibrillated, with irregular bosses and depressions. The cartilage covering the marginal osteophytes is of normal appearance. The acetabular cartilage feels smooth. The osteophytes are of cancellous bone with compact surface and covered by normal cartilage. The changes in the acetabulum are of like kind but less degree.

Of the sixteen operated cases, fourteen were relieved of pain. The inflamed synovial membrane is accumulated in such position as to be compressed by those movements which cause pain in clinical examination; and this compression, and not pressure of the osteophytes against each other, is probably the cause of symptomatic pain. (Operation consisted of removal of the synovial membrane and osteophytes.) Limitation of movement is caused more by muscle spasm than by locking of osteophytes.

The changes are the opposite of those seen in rheumatoid arthritis, where the synovial pannus grows over the cartilage, destroying it in spots; whereas in osteo-arthritis the proliferating bone encroaches upon the synovial membrane. The author feels that osteo-arthritis is due to long continued mechanical misuse of a joint; but that rheumatoid arthritis is infectious in origin.—*Edward N. Reed, M.D., Santa Monica, Calif.*

FRACTURE OF THE CARPAL SCAPHOID. John D. Adams and Ralph Leonard. *New England J. Med.*, CXCVIII, 401, Apr. 12, 1928.

The authors report a new method of treatment in one case of fracture of the carpal scaphoid, considered from both the clinical and roentgenological aspect. They state

that the differential diagnosis between an old ununited and a recent fracture of the scaphoid rests on careful x-ray study of the adjacent surfaces of the fragments. In the ununited fractures, there is invariably an induration of bone along the line of fracture, with smooth surfaces; whereas, in the recent fracture the roentgenogram shows no bony induration, but does reveal the characteristic irregularity of a fresh fracture. The writers cite one sign which they feel to be pathognomonic of an old fracture of the scaphoid, and that is the proliferative bone change which takes place about the tip of the radial styloid. They feel that this is nature's method of attempting to strengthen a wrist joint weakened by a non-union of the scaphoid.

The work of Todd and Kellogg Speed, on the statistics, mechanics, and symptomotology of the injury, is reviewed briefly.

The treatment of the condition is based on the fact that untreated fractures of the scaphoid usually result in non-union. The method of choice shown in their report of one case, is that of bone-grafting. A graft one-half inch in length is removed from the tibia, and inserted into a drill hole in one fragment, and a groove in the other. A plaster cast is applied, including the thumb, with the hand in abduction and flexion. This is left on for six weeks, when passive motion, followed by a light support is started. The case reported is that of a prize-fighter, who returned to his profession at the end of six months, and who has since scored two knock-outs with the injured hand!

The authors note the fact that, during the preparation of the graft bed, there is danger of producing a traumatic arthritis.

The report of one successful case is, of course, inconclusive. The method seems well founded, but further reports on the use of this method should be forthcoming before it is accepted as a standard procedure.—*Henry W. Lamb, M.D., Portland, Maine.*

Sur un cas de Fracture unicondylienne du Femur traitée par l'Osteosynthèse. M. Cornioley (de Geneve). *Société de Paris—Société de Chirurgie. Presse méd.*, XXXVI, No. 11, 167, Feb. 8, 1928.

M. Alglave presents a case of fracture of external condyle which he was unable to reduce, except by open reduction, reducing the fracture and putting in a Lambotte screw; kept in plaster for six weeks. Man walked at the end of three months. States that the first fracture of this sort was operated on thirty years ago by Walther.

The writer states that free incision should be made to expose the crucial ligaments of the fractured area and, if necessary, two screws put in, so that the tendency to dislocation of the fragment will be obviated. He thinks it essential to move knee in about ten days. —*L. A. O. Goddu, M.D., Boston.*

Osteotomie sous-trochantêrienne pour Arthrite sêche de la Hanche. *Sociétés de Province—Société de Chirurgie de Lyon. Presse méd.*, XXXVI, No. 18, 281, Mar. 3, 1928.

M. Rocket describes a case of a woman forty years old with ankylosing arthritis, with hip in poor position, in which he did a subtrochanteric osteotomy, putting the limb in better position. Advantages of this procedure are its simplicity and apparent benignness.—*L. A. O. Goddu, M.D., Boston.*

Fracture isolêe des Apophyses transverses des Vertêbres lombaires avec Résultant et Radiographie trois ans apres. M. Lance and M. Villemin of Nancy. *Société de Paris—Société de Chirurgie. Presse méd.*, XXXVI, No. 17, 263, Feb. 29, 1928.

As the result of a fall, patient received a very serious injury to the lumbar region, presenting marked spasm of lumbar muscles. X-rays showed fractures of transverse processes of the left lumbar region with a greater or less separation. Patient was immobilized in plaster jacket. Seen three years later because of severe pain in the lumbar and sacral nerve region. X-rays showed certain processes were united with a greater or

less exuberant callus formation. Some of them remained isolated. These fractures are seen more frequently than formerly because of the systematic x-ray. The pain seems to appear several weeks after the accident It is sometimes necessary to interfere with the old site of injury to relieve the pain. Diagnosis as the result of the exuberant callus formation is very difficult.—*L. A. O. Goddu, M.D., Boston.*

Fracture de la Colonne Vertebrale intêressant les deuxième et cinquième Vertêbres lombaires. *Sociétés de Paris—Société Anatomique. Presse méd.*, XXXVI, No. 28, 439, Apr. 7, 1928.

M. Menard describes a case in which the patient received a rather severe fall and sustained a fracture of the vertebra body from the second to the fifth lumbar, and left no further sequel than a large kyphos. Diagnosis was only made by x-ray.—*L. A. O. Goddu, Boston.*

Fermeture en Bourse des Moignons D'Amputation. M. M. Desgouttes et A. Ricard, Chirurgiens des Hopitaux de Lyon. *Presse méd.*, XXXVI, No. 24, 373, Mar. 24, 1928.

Describes a circular amputation wherein the wound is closed with a purse-string suture, as giving the very best results as far as healing and cicatrization. The result is a cicatricial tissue which is central and regular. Thigh amputations and upper arm are good. This form is not good in lower arm and lower leg, because of the lack of muscle tissue, and because the tendons did not take well to the central cicatrix. The long posterior flap operations are better on these cases.—*L. A. O. Goddu, Boston.*

The X-ray Diagnosis of Bone Tumors. Edward L. Jenkinson, M.D. *Radiology*, IX, 453, Dec. 1927.

This is a splendid article, packed with detail regarding all kinds of bone tumors; but it does not lend itself to abstracting.

The differentiation between benign and malignant tumors, from the x-ray evidence, receives the fullest consideration. The essential fundamental determination, as to whether the tumor produces bone or destroys bone, is stressed. The author details the usual bony locations, in which metastases from the various types of malignant tumors occur. He makes the observation that whereas an inflammatory process quite commonly passes through and destroys articular cartilage, tumors very rarely invade the articular surfaces or pass through a joint. The changes produced in bone by carcinoma and by gummata are contrasted; as are the differences in the changes produced by tumors and by osteomyelitis. The characteristic bone lesions in carcinoma, sarcoma, and myeloma are differentiated.

The x-ray characteristics of the various bony and cartilaginous tumors, both benign and malignant, are given in great detail. There are a number of good illustrations. —*Edward N. Reed, M.D., Santa Monica, Calif.*

Studies in the Dynamics of Histogenesis, Regarding the Origin, Growth, and Structural Maintenance of Patellar Bone, Knee Joint, and Related Thigh Muscles. Eben J. Carey, M. D. *Radiology*, X, 234, Mar. 1928.

The experiments were: (1) Excision of patella, with suture of the quadriceps tendon to the patellar ligaments; (2) same as (1) but with arthrodesis of the knee joint; (3) patella left intact, with arthrodesis of knee joint. The results were:—(1) regeneration of the patella, of (3) atrophy of patella, of (2) failure of the patella to regenerate. The "adequate mechanical conditions" necessary for a regeneration of the patella after excision are "a normally mobile, exercising articulation, with the soft parts replaced". Both the genesis and the continued existence of the patellar bone, as of other sesamoid bones, are dependent upon the mobility of the knee joint, and remittant pressure and tension produced by the activity of the quadriceps extensor muscle. Neither tension

alone, nor pressure alone, will produce such a bone. There is interdependence in the growth, external form, and internal structure of bone, joint, and muscle; this interdependence operates in the repair of fractures as well as in the development of bone, and is the justification for early massage and mobilization in the treatment of fractures.

Microscopic study of the patella shows trabeculation in two planes; (1) on the ventral, non-articular aspect, from fifteen to thirty plates of lamellar bone, laid down in the direction of pull of the quadriceps and patellar tendons, and called "traction trabeculae"; (2) pressure pillars, laid down at right angles to these, radiating in fan-shape from the articular surface, and formed to support the pressure of the patella against the femoral condyles. These lie dorsal to and do not cut through the traction lamellae on the ventral surface of the bone.

In the lower third of the patella the traction trabeculae are thinned and frayed out, forming a weaker zone,—no doubt one reason for the more frequent occurrence of fracture in this region.—*Edward N. Reed, M.D., Santa Monica, Calif.*

Acute Epiphysitis at the Upper End of the Femur. Pathology and Treatment. Kellogg Speed. *South. Med. J.*, XXI, 208, Mar. 1928.

The hip joint is always involved. The process is very rapid. The joint capsule becomes distended with pus, it ruptures and the pus is disseminated into the surrounding tissues. The head of the femur may become separated. Pathological dislocation often occurs. Pyaemia, secondary abscesses, septic pneumonia, endocarditis, infections of the genito-urinary system are complications. Differential diagnosis is very important and often difficult. It may be mistaken for (1) osteomyelitis, (2) acute coxitis, (3) appendicitis, (4) cystitis or pyelitis, (5) psoas abscess, (6) traumatic separation of head of femur, (7) fracture of neck of femur, (8) tuberculosis of hip, (9) dislocation of hip, (10) Legg Perthes' disease.

Early diagnosis and immediate drainage are most important. Diagnostic aspiration is valuable when pus is found, but it is sometimes missed. Surgical drainage through anterior incision into joint capsule, possibly counter incisions, will be necessary, also immobilization of hip in abduction thirty degrees in plaster cast with windows cut for dressings. Traction in abduction is also used. Dislocated hips should be reduced if possible and held in place in abduction and internal rotation. Old irreducible dislocations may be improved by operations. Braces are of little or no value.—*F. G. Hodgson, M.D., Atlanta, Ga.*

Streptococcic Foci in Arthritis with Special Attention to the Intestinal Tract. Peter M. Keating. *South. Med. J.*, XXI, 263, Apr. 1928.

This is a report of thirty-eight cases studied in detail, including all types of chronic arthritis. He uses the classification of Ely. Of these thirty-eight cases, thirty-five showed streptococci in the stools; some however, only after repeated examinations; thirty-two hemolytic, two viridans, and both forms in two cases. He quotes Maj. S. U. Marietta, M.C. as having found forty-seven positive stool cultures in arthritics, seven private cases were positive, bringing the total to more than ninety cases of arthritis with streptococci in the stools. Of sixteen stools from patients not having arthritis, only three showed streptococci. These three patients had acute infections of the throat or respiratory passages. Of one hundred stools examined from patients with various disorders, about ten per cent. showed streptococci. This is a preliminary report only. He is using autogenous vaccines to improve the patient and to eliminate the streptococci from the stools. In those cases where the streptococci have disappeared from the stools, there has been a remarkable improvement. The type one cases responded more satisfactorily than the type two.—*F. G. Hodgson, M.D., Atlanta, Ga.*

Hip Joint Affections in Children. Oscar L. Miller. *South. Med. J.*, XXI, 287, Apr. 1928.

This is a clear and concise statement of the more common affections of the hip in

children. He discusses: (1) simple arthritis (synovitis); (2) simple epiphysitis; (3) septic epiphysitis (septic hip); (4) tuberculous hip; (5) Legg's disease; (6) epiphyseal or adolescent coxa vara. The symptoms, diagnosis, and treatment of each of these conditions is discussed separately. While it is not an exhaustive thesis on these conditions, it is a well illustrated article and a valuable summary, especially for the general practitioner. He calls especial attention to the fact that many of these conditions may be, and frequently have been, mistaken for tuberculosis of the hip and wrong diagnosis, prognosis, and treatment have resulted.—*F. G. Hodgson, M.D., Atlanta, Ga.*

THE HEALING PROCESS IN FRACTURES. Robert W. Johnson, Jr. *South. Med. J.*, XXI, 394, May 1928.

Stress is laid upon the physicochemical aspects of the healing process in bone which the author contends has been neglected for the purely mechanical reduction and splinting. Failure of bone union, even when mechanical conditions are favorable and satisfactory, can be predicted if the calcium-phosphorous product in the blood falls below thirty-five, and it is probable even when the product is below forty. No case of non-union should be operated upon when the calcium-phosphorous product is below normal. Operation should be delayed for six weeks to three months until proper diet, cod liver oil, and heliotherapy have restored the normal. The importance of the blood supply and circulation to the fracture healing is stressed. Too constrictive splinting must be avoided. Proper healing of fractures depends upon (1) material: adequate supply of calcium and phosphorous in blood; (2) transportation: a good blood supply; and (3) labor: healthy and physiological activity of the bone cells at and near the site of the injury.—*F. G. Hodgson, M.D., Atlanta, Ga.*

REMARKS ON ASYMMETRIES OF THE HUMAN BODY AND THEIR IMPORTANCE IN ORTHOPAEDIC SURGERY. S. Romich. *Ztschr. f. orthop. Chir.*, XL, 1, Dec. 23, 1927.

Attention is called to the asymmetrical construction of the human body which, upon first glance, cannot be detected. Here belong the slight convexity of the mid-line of the face, inequality of the width of the shoulders, the slight deviation of the line of the spine, the obliquity of the pelvis, the unequal length and level of the gluteal folds, etc. These asymmetries, according to the author, also have a functional importance which can be recognized only when the different asymmetrical features are coordinated and properly analyzed. Emphasis is laid especially upon the asymmetry of the sacrum which stands in close connection with the asymmetry of the spine as a whole. Between sacrum and pelvis there exists what the author calls a cross-asymmetry, which is the expression of a functional compensation. The asymmetry is not only confined to the frontal plane but also in the horizontal and sagittal planes, so that one may say that the torsions which lead to asymmetry concern all three axes of the space. So, in the thorax we observe even in flat physiological scoliosis not only an asymmetry in the frontal plane, but also a slight rotation of the ribs, pelvis and sacrum show similar deviation in the three cardinal planes of the body. The same is true of the torsion in the femur, especially in the neck.

So far as the asymmetry of the spine is concerned, the author established that seventy-eight per cent. of the patients examined showed a right convex dorsal and left convex scoliosis, while the right demonstrated the opposite curve. This coincides with the findings of Hoaglund, who found normally in eighty per cent. the right convex and in twenty per cent. the opposite scoliosis. There exists also a causal connection between the curves of the spine and that of the face. In children the facial asymmetry is less marked, but in adults the spinal asymmetry can be recognized in the face.

Of especial importance for the static construction of the body is the asymmetry of the limbs. The statements concerning this point vary. Hoaglund found among 283 children with slight scoliosis a shortening of the left limb in about four-fifths of the cases, the shortening amounting up to two and three-fourths centimeters. Hasse, however,

arrived at opposite findings. He found the left leg longer in fifty-two per cent. of the cases, findings which are corroborated by other observers such as Garson and others.

The author explains discrepancy of these statements by the fact that the material examined belonged to different age periods. The relative difference in the length of the leg changes in later years. The shorter left leg found in school age has not always been the shorter one and does not always remain so. The author believes from his measurements that after puberty the left limb becomes the longer one. So far as the effect of the length of the limb upon the position of the pelvis is concerned it was found that the pelvis acts differently: in some instances the side of the shorter leg is dropped and in others it is elevated, evidently due to the absence of a compensatory sacral scoliosis. The author believes that in those cases in which the pelvis apparently follows the curve of the lumbar spine, that is, in which it is held lower on the side of the convexity, being rotated, however, to the concave side of the lumbar curve, the deformity is still under the influence of active correction relative to obliquity or torsion of the pelvis; whereas, in the opposite case, that is in the so called concave side dropping of the pelvis, the prognosis is not favorable.

(This phenomenon has been described as paradoxical scoliosis; obliquity of the fifth lumbar and scoliosis of the sacrum are probably responsible for this phenomenon.)

The cases with contralateral drop of the pelvis and concave side rotation and the cases of homolateral pelvic drop and convex side rotation, the author considers as transitional conditions. The school has wrongly been made responsible for the occurrence of these asymmetries. The author points out that even in uncivilized races where there is no possibility of this factor existing the same asymmetries of the pelvis have been observed.

Of further interest are the author's investigations in regard to relative length of leg and thigh where he finds crossed asymmetry of thigh and leg upon the opposite side. The knowledge of the asymmetrical skeletal construction, and the recognition of the impairment of function, which follows, gives us a deeper insight into the genesis and origin of static deformities.—*A. Steindler, M.D., Iowa City, Ia.*

A Clinical Contribution on the Tendo Achillis. Patrik Haglund. *Ztschr. f. orthop. Chir.*, XL, 1, Dec. 23, 1927.

The author analyzes the syndromes designated under the collective name of achillodynia.

There are a number of pathological changes often with characteristic syndrome which are represented in this group of cases. One is able to distinguish between post-traumatic and inflammatory conditions and those involving the insertion of the tendon itself and the bursae located at this point. To these groups lately another syndrome has been added which involves disturbances in the growth of the epiphyses of the calcaneus and belongs in the group of epiphysitis with Osgood-Schlatter's disease.

Achillo tendinitis ossificans. Osteomata may be formed in the intratendonous connective tissue. A case of this kind is reported: The tendo Achillis showed a large, hard tumor as in tendinitis or tendovaginitis and the patient suffered from rheumatic-like pains. The x-ray shows a tendinitis ossificans. The etiology of this local occurrence of bone formation in the tendo Achillis is as unclear as in other cases of this type. Inflammatory conditions with oedematous or hemorrhagic infiltrations between the muscle fibers may be responsible.

The intratendinous bone formation in the tendon itself is much more uncommon than the myositis ossificans in which the bone formation occurs in the muscle tissue, although when x-ray examination is applied more regularly to cases with similar objective complaints, it is not unlikely that ossification in the tendon will be found more frequently.

Another type of achillodynia concerns the bursae at the insertion of the tendo Achillis. Here, again, two types may be distinguished according to the seat of the bursa. There is one bursa between tendo Achillis and the upper portion of the posterior surface of the os calcis and another, one not quite constant, is somewhat distally at the

posterior surface of the os calcis as protection against pressure in the different positions and directions in which the foot moves. This latter region is very much exposed to traumatism by the shoe. It is especially the superior bursa that is of orthopaedic interest. This type of achillodynia is very often seen in young people, mostly half-grown girls and young women. The condition is best approached surgically in protracted and resistant cases. After extirpation of the bursa the underlying exostosis designating the upper posterior border of the os calcis is removed. This is not really an exostosis but simply a more distinct and sharp border of the bone protruding against the anterior surface of the tendo Achillis. The cause of the irritation around the bursa between the posterior surface of the os calcis and the lowest portion of the tendo Achillis generally is the pressure of the canter of the shoe against the heel, a pressure which varies with the different types of shoes. The operative removal of the bursa and the filing off of this posterior ledge of the bone gave relief in the cases reported by the author.—*A. Steindler, M.D., Iowa City, Ia.*

CONGENITAL WRY NECK. Walter Aberle. *Ztschr. f. orthop. Chir.*, XL, 1, Dec. 23, 1927.

The author considers the congenital wry neck as a primary aberration of development which may be combined with other intrinsic malformations, and occurs often as a familial deformity. He distinguishes a number of types; first, cases in which there is obliquity and asymmetry of the head, but where changes of the tissues cannot be found in the sternocleido muscle by external examination; in another group there are changes in the muscle, but the latter retains its configuration and it appears as a heavy strand. In a third group there is injury of the degenerated sternocleidomastoid muscle during birth. These are the cases in which one finds tumor-shaped nodes in a muscle already showing degenerative changes. On the other hand, an injury during birth of a healthy muscle not already showing degeneration, leads to a hematoma but never to a true wry neck; this injury heals in a short time.

The asymmetry of the face and skull increases in time but can be stopped by early operation. It is due not to a hemiatrophy but to the usual reaction of the bone which is inhibited by pressure in its normal growth.—*A. Steindler, M.D., Iowa City, Ia.*

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